2.0 PROJECT ALTERNATIVES

This section describes in detail the No Action Alternative, the Beach Fill with Structures Alternative, the Applicant's Preferred Alternative, and alternatives eliminated from detailed consideration. Following publication of the Draft SEIS, an additional alternative was developed and evaluated in an attempt to further reduce the nearshore hardbottom impacts associated with the Applicant's Preferred Alternative. This supplemental alternative, designated the T-head Groin and Reduced Fill Alternative, is evaluated in Appendix M.

The alternative selected must be one which can be reasonably expected to: (1) alleviate the sediment deficit, (2) optimize the performance and cost effectiveness of the Project, (3) restore the recreational beach, (4) provide marine turtle nesting habitat, (5) provide storm protection for upland property and infrastructure, and (6) minimize environmental impacts to the nearshore hardbottom resources. In addition, the alternative selected must be feasible. As applied to the alternatives considered in Section 2.0 of the FSEIS, the feasibility of an alternative is evaluated using two fundamental criteria: (1) the extent to which the alternative will likely satisfy the project purposes, as stated by the Applicant; and (2) the extent to which the alternative is cost-effective and can be permitted. Both criteria must be met for the alternative to be considered feasible.

Based on the information and analysis in Section 3.0, Affected Environment and Section 4.0, Environmental Consequences, the Project Alternatives discussion presents the beneficial and detrimental environmental impacts of the Applicant's Preferred Alternative and other alternatives in a comparative form. This section, in combination with others, is intended to provide a clear basis for choice among options available to the decision maker and the public. This section provides substantial detail for each alternative considered including the Applicant's Preferred Alternative so that reviewers may evaluate the comparative merits of all alternatives.

Consistent with guidance in 33 CFR 325, Appendix A, some alternatives presented here are considered feasible, will accomplish the Applicant's underlying purpose and need for the project, and satisfy the requested federal action for project authorization. Other alternatives are included even though they are not considered feasible or cost-effective by the Applicant and/or do not fulfill the project purposes as outlined by the Applicant. As explained in this section and in Appendix M, the following alternatives -- while considered in detail -- have considerable shortcomings and would either not be cost-effective for the Applicant or would not fulfill the Applicant's project purposes: Alternative 1 - "No Action," Alternative 2 – Beach Fill with Structures, and the Supplemental Alternative - T-Head Groin and Reduced Fill.

The proposed action is the issuance by the USACE of the Section 404/Section 10 permit necessary for authorization and construction of the Applicant's Preferred Alternative, as set forth below. The detailed analysis of the alternatives included below is intended to support both the public interest review and the 404(b)(1) guidelines reviews, where applicable.

2.1. Description of Alternatives Evaluated in Detail

In this section, the analysis will explore and objectively evaluate the No Action Alternative and other alternatives and their capacity to accomplish the Project purpose and need. The four Project alternatives considered in greatest detail are:

- Alternative 1 - No Action Alternative
- Alternative 2 - Beach Fill with Structures Alternative
- Alternative 3 - Applicant's Preferred Alternative, Beach Fill with Periodic Renourishment

- Supplemental Alternative – T-Head Groin and Reduced Fill Alternative (see Appendix M)

2.1.1 Alternative 1 - No Action Alternative

The No Action Alternative involves no construction, fill placement or other action requiring a USACE permit. The No Action Alternative may result from either: (1) the Applicant electing to modify the Project to eliminate work under the jurisdiction of the USACE; or (2) by denial of the permit by the USACE.

Exposed (visible above the surrounding substrate) natural rock or "hardbottom" exists sporadically along most of the shoreline of Palm Beach Island, as illustrated in the "Hardbottom Maps" contained in Appendix C. Within the Applicant's Proposed Project Area, inter-tidal formations of hardbottom are usually visible above the waterline between reference monuments R-118 and R-120. Most of the Project Area contains subterranean hardbottom features, buried beneath the beach grade and/or subtidal hardbottom which are exposed above the surrounding substrate but below the surface of the water even at low tide. These hardbottom and rock features affect the shoreline response under existing conditions and future conditions associated with "No Action". In response to comments surrounding the DRAFT Final SEIS, the Applicant conducted a "field survey" within the Project Area to document the elevation of existing hardbottom and rock outcrop features below the beach and in the immediate nearshore region. The November 2003 field survey documents that low-profile, low rugosity, low-elevation rock exists both above and below the beach grade throughout most of the Project Area, particularly between DNR Monuments R-116 to R-124. Figure 2.1 identifies the maximum elevations of rock along each transect within the Project Area as surveyed at each reference monument. Appendix N contains profiles illustrating the existing rock as surveyed and also in the nearshore area as mapped by Continental Shelf Associates, Inc. in 1999 (see Section 1.7, Related Environmental Documents). Appendix N also contains profiles illustrating the rock elevations as surveyed in the Project Area relative to existing structures and projected storm surge and shoreline retreat expected under a 100-year return interval storm.

The shoreline corresponds to the mean high water line, which occurs at +1.9 feet NGVD. As shown in Figure 2.1, the rock within Phipps Project Area is at or above the mean high water elevation of +1.9 from R-116 to R-124, and, as a result, the rock prevents shoreline recession landward of the rock. However, as discussed in Appendix N, the rock is ineffective in preventing damage to upland structures under moderate to severe storm conditions. From R-124 to R-126, the rock is below the mean high water elevation and the shoreline may recede landward of the rock.

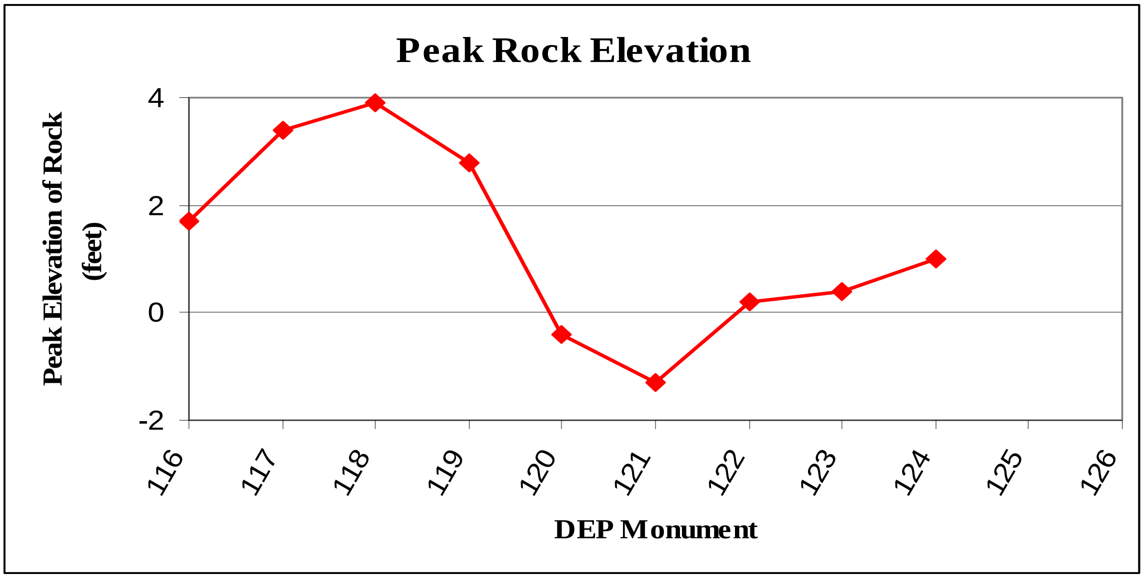


Figure 2.1 Maximum Elevation of Rock Within Project Area – As Surveyed

In addition, in response to comments surrounding the DRAFT Final SEIS, the Applicant updated the historic shoreline position data through 2003, and re-assessed the expected "No Action" shoreline response now including consideration of the extent of rock and elevation of rock determined from the November 2003 field survey results. As summarized in Appendix J, and consistent with the approach used to assess all alternatives evaluated in detail, a numerical model (GENESIS) was applied to predict the future shoreline position at two, four, six and eight years following 1999, based upon selection of the No Action Alternative. Figure 2.2a and Figure 2.2b are plan view depictions of the Project Area with the model results (for 4 & 8 years) superimposed upon historical shoreline positions; note that the east-west scale is exaggerated to illustrate the relative historical shoreline positions. The GENESIS model predicts a 2003 shoreline (4 years after 1999) more landward than the surveyed 2003 shoreline. In addition, although the shoreline receded in the vicinity of R-120 and R-124 (as predicted by the model), otherwise, the 1999 shoreline is predominantly coincident with the 2003 shoreline. The GENESIS model over predicts erosion of the shoreline. Due to the influence of the rock outcrops and the historical shoreline fluctuations, the GENESIS model results are insufficient alone to reliably predict future shoreline conditions.

Figure 2.2a - "No Action" Alternative
GENESIS Results Afer 4 Years

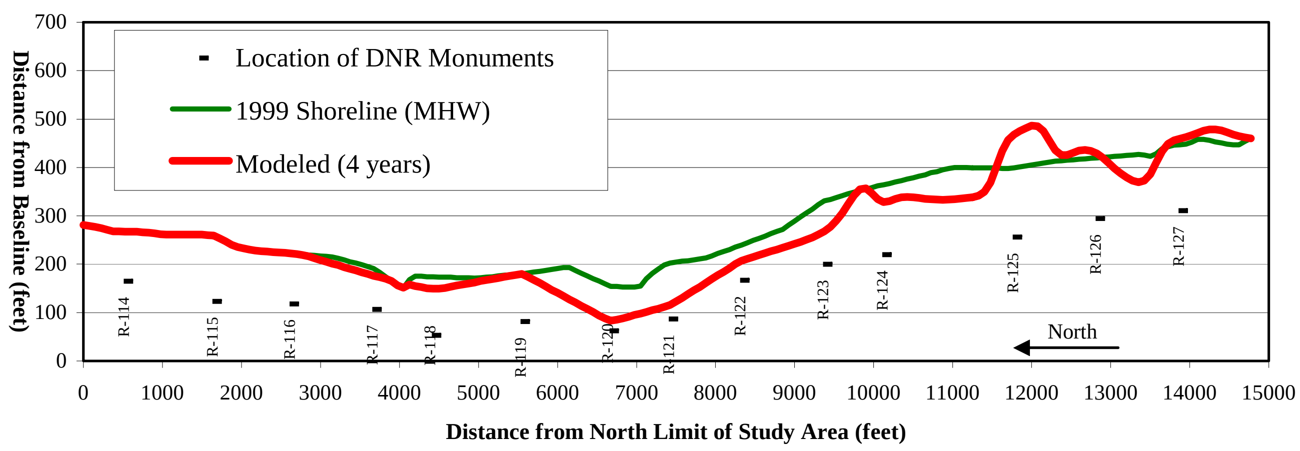


Figure 2.2b - "No Action" Alternative
GENESIS Results Afer 8 Years

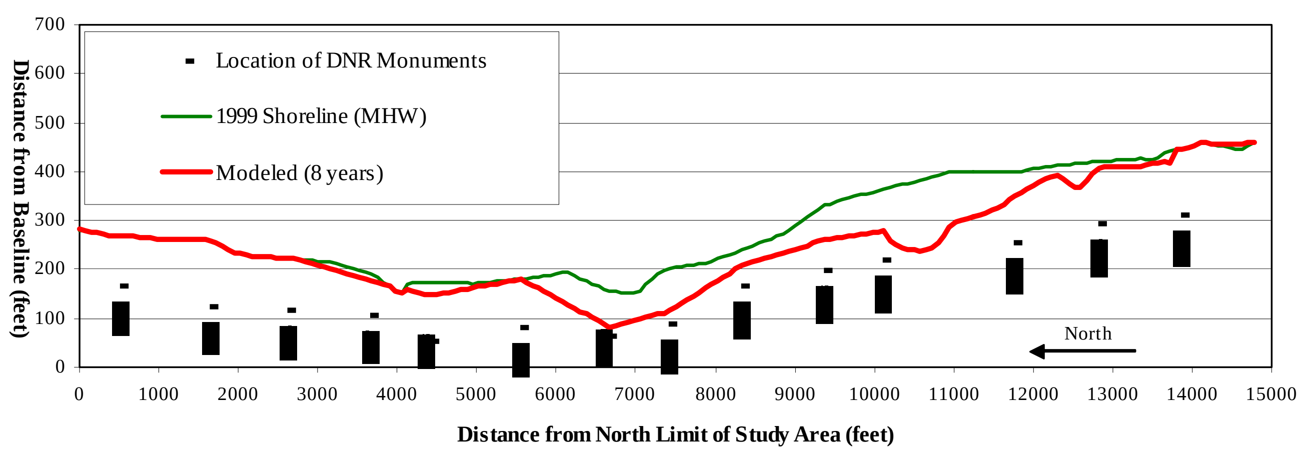


Figure 2.3 illustrates historical shoreline positions from 1883 to 2003. Since 1970, the shoreline within the Project Area has fluctuated with varying periods of landward recession and seaward advance. However, it must be noted that the Project Area shoreline has receded significantly from its 1883 position. These fluctuations are in part attributable to the influence of the rock outcrops and longshore transport reversals, both of which are not well predicted by the GENESIS model. Although the peak rock elevations do not extend to the mean high water line (+1.9' NGVD) throughout the project area, rocks exists near or above this elevation throughout most of the Project Area and in particular between DNR Monuments R-116 and R-124. These higher elevation rock features do indeed impact shoreline position and have limited shoreline recession in portions of the Project Area.

The shoreline embayment, as reflected in Figure 2.3, appears to trap sand during northerly directed transport resulting in shoreline advance. Overall, in recognition of the above considerations, the future shoreline associated with the No Action Alternative is expected to fluctuate within a range defined by historical fluctuations as illustrated in Figure 2.3. For planning purposes, the future shoreline associated with the No Action Alternative is equivalent to the existing shoreline condition subject to fluctuations as illustrated in Figure 2.3. It is extremely important to note that: (1) these fluctuations may result in shoreline recession on the order of 50 feet, and (2) although, over the long term, shoreline fluctuations are expected, the potential exists for significant net loss of sand and net recession over time in association with storm events.

Finally, in response to comments on the DRAFT Final SEIS, the Applicant investigated the vulnerability of upland structures associated with 10, 20, 50 and 100-year return interval storm events based upon the November 2003 survey results. This investigation produced a report titled "Storm Impact Risk Assessment, Phipps Ocean Park Beach Restoration Project, Palm Beach County, Florida" (Taylor Engineering, Inc., December 2003); the entire report is contained in Appendix N.

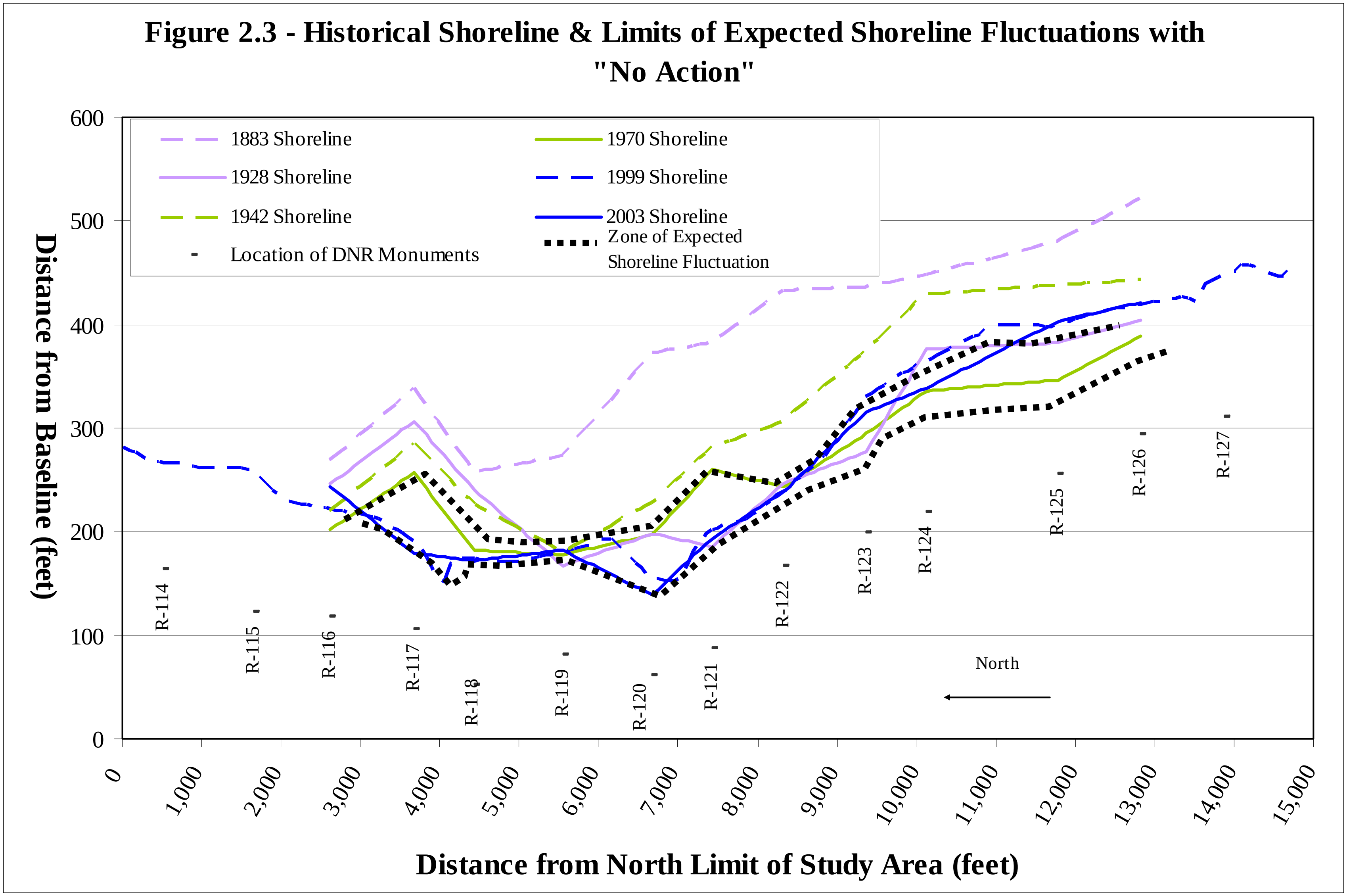


Figure 2.3 - Historical Shoreline & Limits of Expected Shoreline Fluctuations with "No Action"
1883 Shoreline
1928 Shoreline
1942 Shoreline
Location of DNR Monuments
1970 Shoreline
1999 Shoreline
2003 Shoreline
Zone of Expected Shoreline Fluctuation
Distance from Baseline (feet)
Distance from North Limit of Study Area (feet)
R-114
R-115
R-116
R-117
R-118
R-119
R-120
R-121
R-122
R-123
R-124
R-125
R-126
R-127
North

During annually occurring severe northeast storms, waves in the Project Area are commonly observed in excess of +6 NGVD feet in height. The higher rock formations provide some minimal protection to the uplands during normal tides low wave heights. However, under moderate seas or storm conditions, these rock formations are easily overtopped by storm surge and waves, providing no storm protection to upland properties and leaving upland property vulnerable to erosion and structures vulnerable to direct physical damage and significant water damage caused by storm surge which can typically exceed 10 feet.[1] The existing nearshore rock features, which limit fluctuation of the shoreline in some portions of the Project Area, do not provide any protection for upland property and improvements from storms or the rising water associated with storm surge.

Taylor Engineering (Appendix N) assessed the risk of damage to upland property and improvements for existing conditions, which are equivalent to the future conditions associated with the No Action Alternative. Taylor Engineering employed two methods. Method 1 applied the recession versus storm return period curve reported in Coast of Florida Erosion and Storm Effects Study (USACE, 1996) for the segment of beach between Lake Worth Inlet and South Lake Worth Inlet in Palm Beach County (which includes the Phipps Ocean Park Project area). Method 2 applied the SBEACH (Storm-Induced Beach Change) cross-shore transport numerical model with calibrated coefficients derived in the more recent General Design Memorandum Addendum for the Ocean Ridge Segment in Palm Beach County (Olsen Associates, Inc., 1996). The Ocean Ridge segment of Palm Beach County lies approximately six miles south of the Phipps Ocean Park Project area. The pre-storm profile data used for this modeling is the 2001 database because it represents the most recent complete data set including elevations along both the dry beach and out to 1 mile offshore. It is important to note that, although the two methods yielded varying results, both methods confirmed that the No Action Alternative resulted in substantial risk to significant existing upland structures as identified in Appendix N.

Table 2.1 identifies the number and specific structures impacted by 10, 20, 50, and 100-year return interval storm events for Methods 1 and 2 in the absence of a beach nourishment project. Using Method 1, five upland structures, including the 2100 Sloans Curve Townhouses and Condominiums, the Reef Condos, and the Palm Beach White House Condos, are at risk of substantial storm damage if the No Action Alternative is selected. Under Method 2, 19 of 28 upland structures in the Project Area are at risk of substantial storm damage in a 100-year return interval storm; seven structures would likely be damaged in a 20-year return interval storm and 15 structures would likely be damaged in a 50-year return interval storm. As explained in Appendix N, the Method 2 approach, consistent with the typical approach employed when appropriate storm data for calibration are available, is generally superior to the Method 1 approach. In the professional opinion of both Coastal Tech, Inc. and Taylor Engineering, Inc. Method 1 provides a more reliable prediction of storm damage effects in this area.

[1] As explained in Appendix N and in the figures provided, the peak storm surge associated with the 100-year return period storm is +10.7 ft-NGVD. However, wave runup, the uprush of water up a slope from the breaking of a wave, will exceed the peak storm surge elevation. The Appendix N figures show the maximum wave runup elevation specific for each profile location. The average seaward limit of the structure is a weighted average calculated with respect to the width of the structure.

In response to comments on the Draft Final SEIS, the storm damage risk of the No Action Alternative presented here and in Appendix N must also be examined in light of the Coastal Construction Control Line (CCCL) in the Project area as established in Palm Beach County in 1997 by the Florida Department of Environmental Protection (FDEP). An understanding of the CCCL is also relevant to the storm risk analysis discussed in Section 2.1.3, Alternative 3 – Applicant's Preferred Alternative, Beach Fill with Periodic Nourishment.

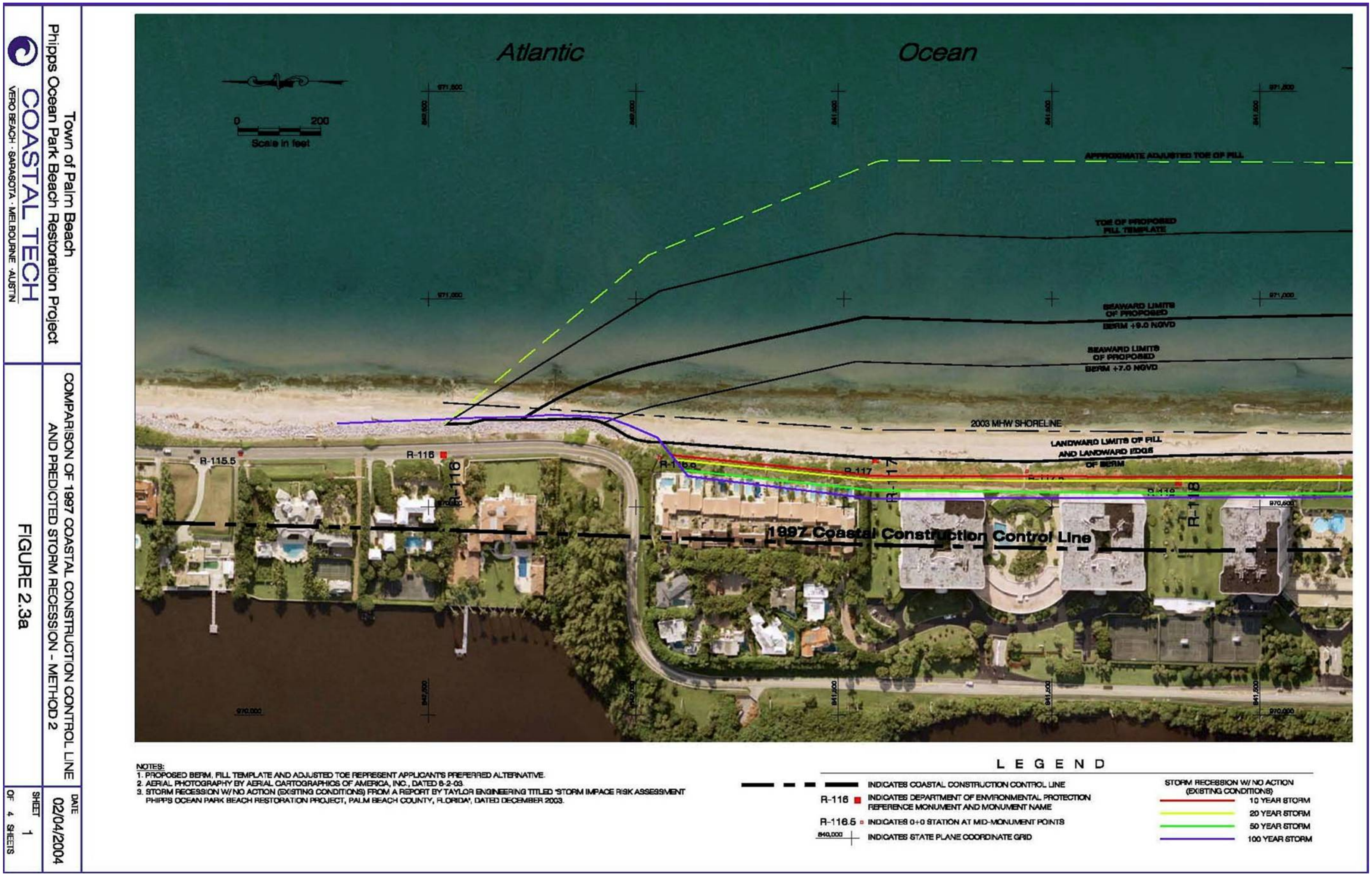
Figures 2.3a through 2.3d illustrate the location of the CCCL. As identified in Chapter 161.053 of Florida Statutes (F.S.), the CCCL was developed as regulation "necessary for the protection of upland properties and the control of beach erosion" and the CCCL defines "that portion of the beach-dune system which is subject to severe fluctuations based on a 100-year storm surge, storm waves, or other predictable weather conditions." However, the statute prescribes that FDEP "may establish a segment or segments of a coastal construction control line further landward than the impact zone of a 100-year storm surge, provided such segment or segments do not extend beyond the landward toe of the coastal barrier dune structure that intercepts the 100-year storm surge." As cited in the statute: "Special siting and design considerations shall be necessary seaward of established coastal construction control lines to ensure the protection of the beach-dune system, proposed or existing structures, and adjacent properties and the preservation of public beach access"; such "considerations" are imposed by the State under FDEP's regulatory program.

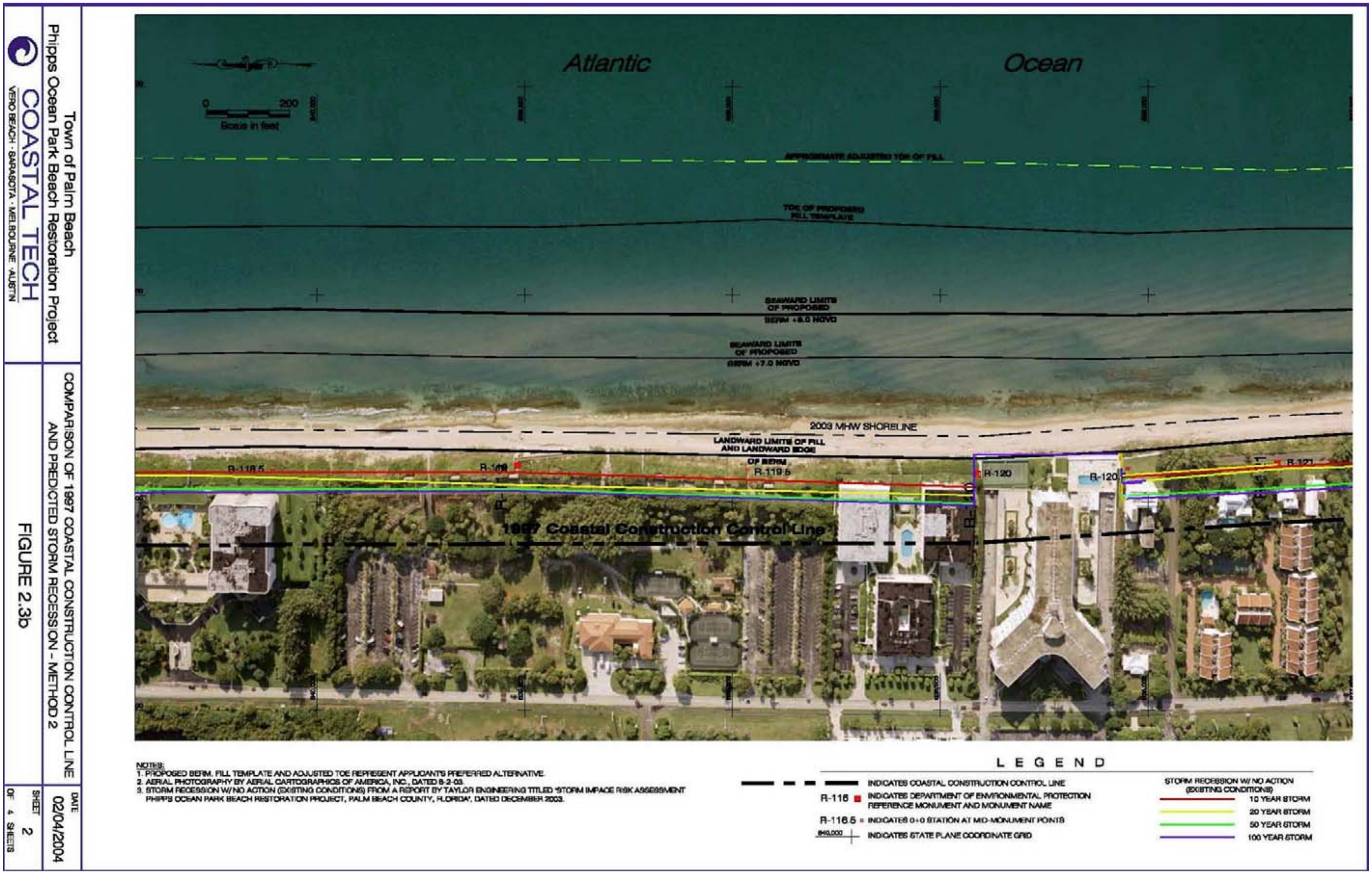
Within the Project area, the position of the CCCL is 75 to 150 feet landward of the limits of erosion for a 100-year storm as identified by the detailed analysis provided in Appendix N. FDEP's model is highly conservative; specifically, FDEP's model (a) is calibrated against erosion data associated with Hurricane Eloise of 1975 (FSU, 1992), which made landfall and overtopped dunes in the Florida panhandle, and (b) does not consider the effects of seawalls and rock outcrops. As a result, FDEP's model over-predicts erosion in conditions where the dune is not overtopped and/or where seawalls or rock outcrops exist. The detailed analysis provided in Appendix N considers the effects of existing sea walls and is based upon application of the SBEACH model, which assumes that the dune is not overtopped. The conservative FDEP approach has prompted challenges to the establishment of the CCCL in numerous Florida counties. Specifically in Palm Beach County, in 1997, "*Concerned Citizens of Highland Beach*" challenged the proposed Palm Beach County CCCL and the associated computer model relative to the significantly landward relocation of the CCCL as proposed by FDEP (Mayton, 1997). Based upon the above, the SBEACH model results presented in Appendix N and discussed here in Section 2.1.1, Alternative 1 – No Action Alternative, are a more accurate estimate of the extent of erosion and damages to existing property that could be expected in association with a 100-year storm event. As indicated in Figures 2.3a through 2.3d, use of the CCCL to predict storm damage in the project area would result in a prediction that approximately **95** percent of the structures within the Project area would sustain significant damage in the event of a 100-year storm as compared to 18 to 68 percent as identified in Appendix N.

Table 2.1 - Structures Impacted with No Action Alternative

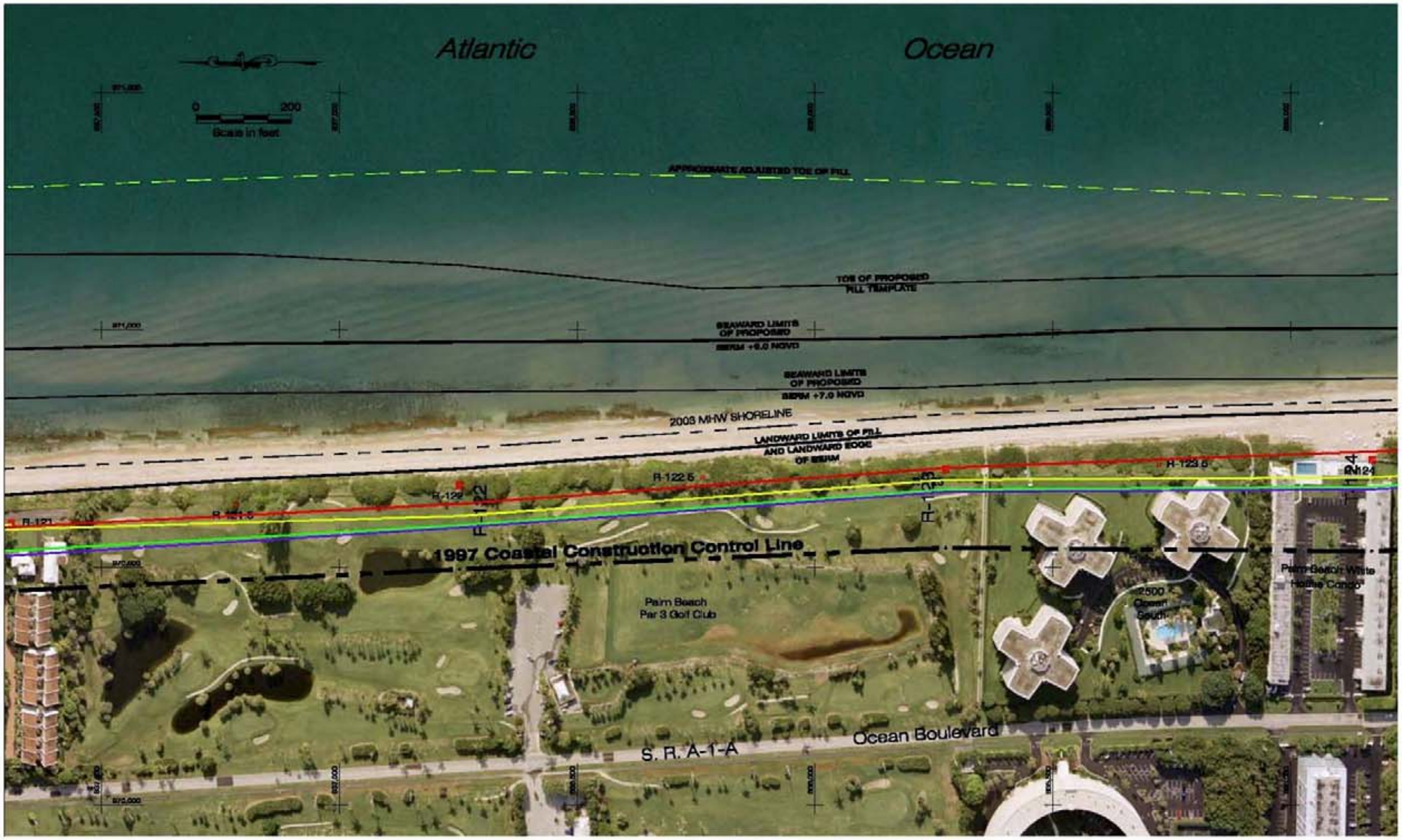
Structure #	Description	Nearest Monument	Return Period Storm Impact							
			10-Year		20-Year		50-Year		100-Year	
			Method 1	Method 2	Method 1	Method 2	Method 1	Method 2	Method 1	Method 2
Total Number of Structures Impacted			0	2	3	7	5	15	5	19
1	Sloans Curve Townhouses	R-117								
2	2000 Condo Sloans Curve	R-117								
3	2000 Condo Sloans Curve	R-118								
4	2100 Condo Sloans Curve	R-118								
5	2100 Condo Sloans Curve	R-118								
6	2275 South Ocean The Reef Condo	R-120								
7	2275 South Ocean The Reef Condo	R-120								
8	2295 South Ocean Harbor House	R-120								
9	2295 South Ocean Harbor House	R-120								
10	2295 South Ocean Harbor House	R-120								
11	2320 South Ocean	R-121								
12	2330 South Ocean	R-121								
13	2340 South Ocean	R-121								
14	2500 South Ocean Condo	R-123								
15	2500 South Ocean Condo	R-124								
16	2545 South Ocean Palm Beach White House	R-124								
17	2565 South Ocean Palm Beach White House	R-124								
18	2580 South Ocean Stratford	R-124								
19	2600 South Ocean The 2600	R-124								
20	2600 South Ocean The 2600	R-124								
21	2660 South Ocean Beach Point	R-125								
22	2660 South Ocean Beach Point	R-125								
23	2660 South Ocean Beach Point	R-125								
24	2730 South Ocean Ambassador Hotel	R-125								
25	2770 South Ocean	R-125								
26	2770 South Ocean	R-125								
27	2774 South Ocean Ambassador South Cooperative	R-126								
28	2780 South Ocean Ambassador II Cooperative	R-126								

shaded box indicates storm impact


Atlantic
Ocean
0
200
Scale in feet
APPROXIMATE ADJUSTED TOE OF FILL
TOE OF PROPOSED FILL TEMPLATE
SEAWARD LIMITS OF PROPOSED BERM +9.0 NGVD
SEAWARD LIMITS OF PROPOSED BERM +7.0 NGVD
2003 MHW SHORELINE
LANDWARD LIMITS OF FILL AND LANDWARD EDGE OF BERM
R-115.5
R-116
R-117
R-118
1997 Coastal Construction Control Line
NOTES:
1. PROPOSED BERM, FILL TEMPLATE AND ADJUSTED TOE REPRESENT APPLICANT'S PREFERRED ALTERNATIVE.
2. AERIAL PHOTOGRAPHY BY AERIAL CARTOGRAPHICS OF AMERICA, INC., DATED 8-2-03.
3. STORM RECESSION W/ NO ACTION (EXISTING CONDITIONS) FROM A REPORT BY TAYLOR ENGINEERING TITLED "STORM IMPACE RISK ASSESSMENT PHIPPS OCEAN PARK BEACH RESTORATION PROJECT, PALM BEACH COUNTY, FLORIDA", DATED DECEMBER 2003.
LEGEND
INDICATES COASTAL CONSTRUCTION CONTROL LINE
R-116 INDICATES DEPARTMENT OF ENVIRONMENTAL PROTECTION REFERENCE MONUMENT AND MONUMENT NAME
R-116.5 INDICATES 0+0 STATION AT MID-MONUMENT POINTS
840,000 INDICATES STATE PLANE COORDINATE GRID
STORM RECESSION W/ NO ACTION (EXISTING CONDITIONS)
10 YEAR STORM
20 YEAR STORM
50 YEAR STORM
100 YEAR STORM
COASTAL TECH
VERO BEACH · SARASOTA · MELBOURNE · AUSTIN
Town of Palm Beach
Phipps Ocean Park Beach Restoration Project
COMPARISON OF 1997 COASTAL CONSTRUCTION CONTROL LINE AND PREDICTED STORM RECESSION - METHOD 2
FIGURE 2.3a
DATE 02/04/2004
SHEET 1 OF 4 SHEETS



Atlantic
Ocean
0
200
Scale in feet
APPROXIMATE ADJUSTED TOE OF FILL
TOE OF PROPOSED FILL TEMPLATE
SEAWARD LIMITS OF PROPOSED BERM +9.0 NGVD
SEAWARD LIMITS OF PROPOSED BERM +7.0 NGVD
2003 MHW SHORELINE
LANDWARD LIMITS OF FILL AND LANDWARD EDGE OF BERM
R-119.5
R-120
1997 Coastal Construction Control Line
NOTES:
1. PROPOSED BERM, FILL TEMPLATE AND ADJUSTED TOE REPRESENT APPLICANT'S PREFERRED ALTERNATIVE.
2. AERIAL PHOTOGRAPHY BY AERIAL CARTOGRAPHICS OF AMERICA, INC., DATED 8-2-03.
3. STORM RECESSION W/NO ACTION (EXISTING CONDITIONS) FROM A REPORT BY TAYLOR ENGINEERING TITLED "STORM IMPACE RISK ASSESSMENT PHIPPS OCEAN PARK BEACH RESTORATION PROJECT, PALM BEACH COUNTY, FLORIDA", DATED DECEMBER 2003.
LEGEND
INDICATES COASTAL CONSTRUCTION CONTROL LINE
R-116 INDICATES DEPARTMENT OF ENVIRONMENTAL PROTECTION REFERENCE MONUMENT AND MONUMENT NAME
R-116.5 INDICATES 0+0 STATION AT MID-MONUMENT POINTS
840,000 INDICATES STATE PLANE COORDINATE GRID
STORM RECESSION W/ NO ACTION (EXISTING CONDITIONS)
10 YEAR STORM
20 YEAR STORM
50 YEAR STORM
100 YEAR STORM
Town of Palm Beach
Phipps Ocean Park Beach Restoration Project
COASTAL TECH
VERO BEACH · SARASOTA · MELBOURNE · AUSTIN
COMPARISON OF 1997 COASTAL CONSTRUCTION CONTROL LINE AND PREDICTED STORM RECESSION - METHOD 2
FIGURE 2.3b
DATE 02/04/2004
SHEET 2
OF 4 SHEETS



NOTES:
1. PROPOSED BERM, FILL TEMPLATE AND ADJUSTED TOE REPRESENT APPLICANT'S PREFERRED ALTERNATIVE.
2. AERIAL PHOTOGRAPHY BY AERIAL CARTOGRAPHICS OF AMERICA, INC., DATED 6-2-03.
3. STORM RECESSION W/ NO ACTION (EXISTING CONDITIONS) FROM A REPORT BY TAYLOR ENGINEERING TITLED "STORM IMPACE RISK ASSESSMENT PHIPPS OCEAN PARK BEACH RESTORATION PROJECT, PALM BEACH COUNTY, FLORIDA", DATED DECEMBER 2003.

LEGEND

INDICATES COASTAL CONSTRUCTION CONTROL LINE
R-116 INDICATES DEPARTMENT OF ENVIRONMENTAL PROTECTION REFERENCE MONUMENT AND MONUMENT NAME
R-116.5 INDICATES 0+0 STATION AT MID-MONUMENT POINTS
840,000 INDICATES STATE PLANE COORDINATE GRID

STORM RECESSION W/ NO ACTION (EXISTING CONDITIONS)
10 YEAR STORM
20 YEAR STORM
50 YEAR STORM
100 YEAR STORM

Town of Palm Beach
Phipps Ocean Park Beach Restoration Project
COASTAL TECH
VERO BEACH · SARASOTA · MELBOURNE · AUSTIN
COMPARISON OF 1997 COASTAL CONSTRUCTION CONTROL LINE AND PREDICTED STORM RECESSION - METHOD 2
FIGURE 2.3c
DATE 02/04/2004
SHEET 3 OF 4 SHEETS

Town of Palm Beach
Phipps Ocean Park Beach Restoration Project

COASTAL TECH
VERO BEACH · SARASOTA · MELBOURNE · AUSTIN

COMPARISON OF 1997 COASTAL CONSTRUCTION CONTROL LINE
AND PREDICTED STORM RECESSION - METHOD 2

FIGURE 2.3d

DATE 02/04/2004
SHEET 4 OF 4 SHEETS

NOTES:
1. PROPOSED BERM, FILL TEMPLATE AND ADJUSTED TOE REPRESENT APPLICANTS PREFERRED ALTERNATIVE.
2. AERIAL PHOTOGRAPHY BY AERIAL CARTOGRAPHICS OF AMERICA, INC., DATED 8-2-03.
3. STORM RECESSION W/ NO ACTION (EXISTING CONDITIONS) FROM A REPORT BY TAYLOR ENGINEERING TITLED "STORM IMPACE RISK ASSESSMENT PHIPPS OCEAN PARK BEACH RESTORATION PROJECT, PALM BEACH COUNTY, FLORIDA", DATED DECEMBER 2003.

LEGEND

INDICATES COASTAL CONSTRUCTION CONTROL LINE
R-116 INDICATES DEPARTMENT OF ENVIRONMENTAL PROTECTION REFERENCE MONUMENT AND MONUMENT NAME
R-116.5 INDICATES 0+0 STATION AT MID-MONUMENT POINTS
840,000 INDICATES STATE PLANE COORDINATE GRID

STORM RECESSION W/ NO ACTION (EXISTING CONDITIONS)
10 YEAR STORM
20 YEAR STORM
50 YEAR STORM
100 YEAR STORM

The total value of the upland structures landward of the Applicant's proposed project exceeds $500 million.[2] The potential storm damage to properties within the Project Area would be substantial if the No Action Alternative were selected. For example, in a 50-year return interval storm, the Sloan's Curve Townhouses are expected to be damaged. Currently, there are 14 beachfront townhouses in Sloan's Curve Townhouse area, ranging in value from $1.5 to $3.5 million each or about $27.72 million total, which would be substantially impacted a 50-year storm, if no action is taken. The Reef Condominium complex, which includes 129 units averaging a minimum of $250,000 each, has a collective value exceeding $32.2 million. If the No Action Alternative is selected, this complex is expected to be damaged in a 10-, 20, -50, and 100-year return interval storm. Other significant properties at risk include the 2500 South Ocean Condominiums – $60 million (120 units valued at approximately $500,000 per unit); Stratford Condominiums - $19.5 million (78 units valued at approximately $250,000 per unit); Palm Beach White House Condominium – $19.25 (154 units valued at approximately $250,000 per unit); and the Beach Point Condominiums - $94 million (188 units valued at approximately $500,000 per unit). Each of these properties is expected to be damaged under projected storm conditions if no action is taken to restore the beach. Storm damage evaluations in the vicinity of the Project Area have also been calculated by the USACE in the 1987 Palm Island GDM/EIS and the 1996 COFS. In each case the calculated storm damage reduction benefit exceeded $100 million.

Given the instability of the Project Area shoreline overall, the net loss of sand and net retreat of the shoreline over time and predicted future fluctuations, there is no reasonable expectation that the Project purpose and need would be addressed by the No Action Alternative. Based on these studies, opting to employ the No Action Alternative would be non-responsive to the primary goal of the project to enhance storm protection to upland properties and is thus inconsistent with the Town of Palm Beach Comprehensive Coastal Management Plan and irresponsible to the residents of the Town.

[2] Property values for the Project Area were obtained from the Palm Beach County Property Appraiser's Public Access web site. The total value of upland properties was calculated based on the market value of each parcel, if available. Because condominium units are individually owned and appraised, an estimated value of each condominium structure was developed based on a random selection of at least 10% of the units within each building. Appendix N identifies structures subject to storm damage. The valuation of expected storm damage with the No Action Alternative was derived from the storm damage analysis in Appendix N and structure values provided by the Palm Beach County Property Appraiser's Public Access web site. These figures should be considered approximate values only.

While the No Action Alternative would avoid any adverse impact to nearshore hardbottom resources, this alternative fails to meet the Project purpose or need and is not viable.

The rock formations do not provide any significant storm protection. The No Action Alternative does not benefit the severely diminished recreational beach area, sea turtle nesting habitat or offset the sediment deficit caused by Lake Worth Inlet and other updrift structures. The No Action Alternative fails entirely to mitigate for the negative effects of Lake Worth Inlet, and is not a responsible long term sand management practice.

In conclusion, there is no reasonable basis to conclude that the No Action Alternative, and the presence of rock outcrops along the Project Area shoreline, can fulfill any of the Project purposes described in Section 1.2 of the FSEIS.

2.1.2 Alternative 2 – Beach Fill with Structures

The second alternative response to shoreline erosion in the Project Area is to implement a beach nourishment project in combination with installation of a groin field. In some cases, the cost of installing groins in combination with beach fill can be justified to reduce sediment losses and the frequency and cost of future renourishment. Under some conditions, groins can aid in retention of placed sand and reduce negative environmental consequences associated with renourishment of the Project Area. By trapping and retaining sand, groins inherently reduce sediment transport to downdrift beaches and can increase erosion of downdrift beaches. In these cases, additional fill of the downdrift beaches may be recommended to prevent increased erosion to these beaches.

Several groin configurations are possible; however, the Beach Fill with Structures Alternative evaluated involves installation of six groins spaced at approximately 450-ft intervals, beginning 700 feet north of Phipps Ocean Park and ending 400 feet south of the Park. The placed fill volume would be 1.5 million cubic yards between DNR Monuments R-116 and R-126. The estimated Project cost would be $8.55 million for the fill material and $1.64 million for the groins. Following publication of the Draft SEIS, an additional beach fill with structures alternative (T-Head Groins with Reduced Fill) was evaluated and is included in Alternative M.

For Alternative 2, Beach Fill with Structures, the GENESIS model was used to assess the expected performance of the project configuration. For all simulations, permeable rock groins with a crest elevation of +5.0 feet NGVD and extending 150 feet seaward of the 1999 shoreline were assumed. The groins, represented in the model, were assumed to retain 90% of the sand they impounded.

The three northernmost groins are projected to retain minor pocket beaches on the order of 20 feet of additional dry beach eight years after the initial nourishment (Figure 2.4d). Figures 2.4a through 2.4c shows the predicted shoreline based on GENESIS models run results for two, four and six years. The additional dry beach width after eight years would be limited to approximately 1,400 linear feet of shoreline within the northern three groins. The other groins remain largely buried by the beach fill and have no positive effect on fill performance. In all, the northern groins can be expected to retain approximately 10,000 cubic yards of sand after eight years, thereby slightly reducing future renourishment volumes.

With the cost of sand estimated for the initial Project at $4.50 per cubic yard, and assuming a 3% annual inflation rate, installation of groins would reduce the renourishment cost in year eight by approximately $57,000. Assuming similar cost savings beyond the first renourishment cycle, installation of groins at a cost of more than $1 million is not cost-effective.

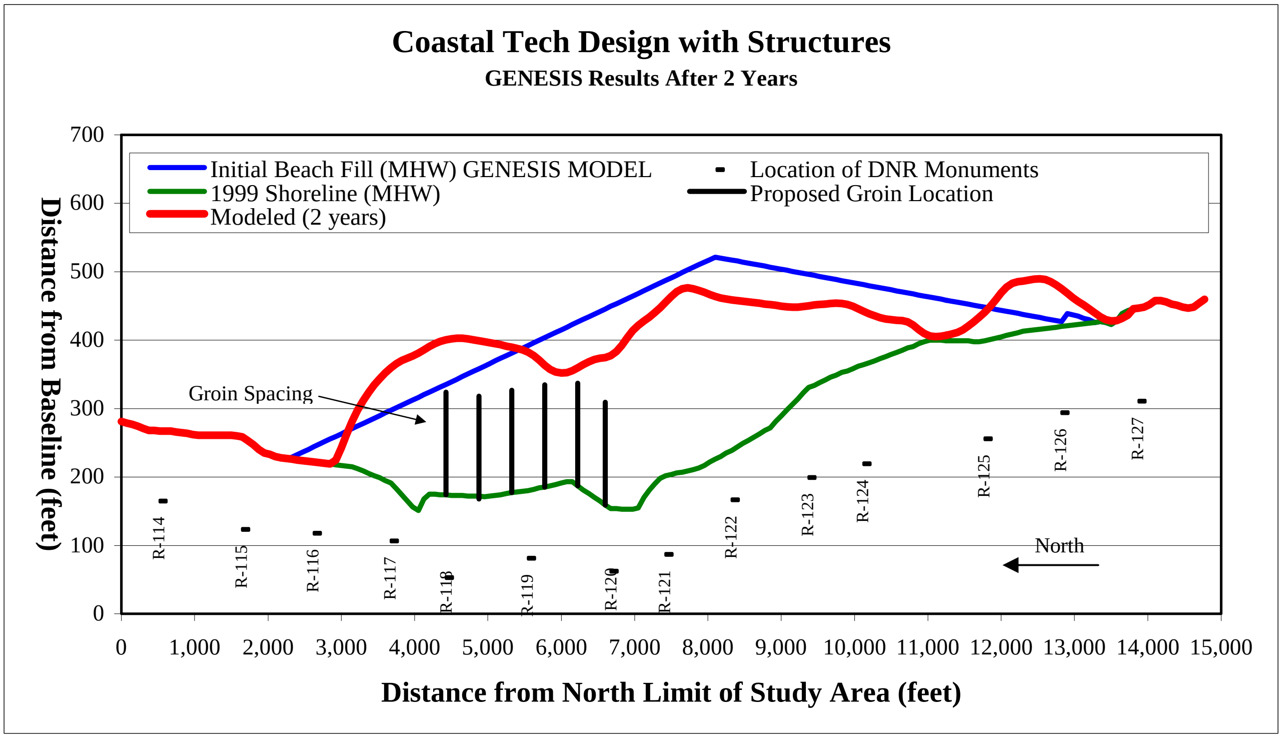
2.1.3 Alternative 3 - Applicant’s Preferred Alternative, Beach Fill with Periodic Renourishment

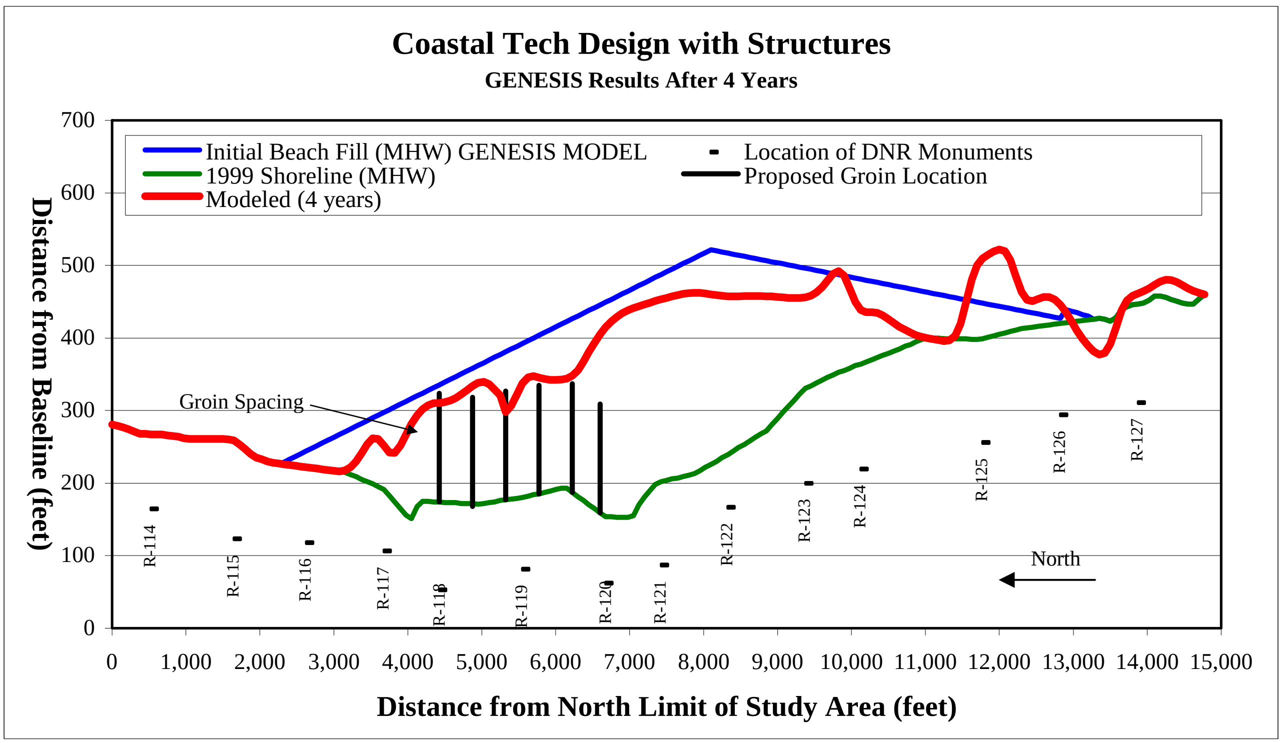
Consistent with the analysis set forth in the 1987 Palm Beach Island GDM.EIS and the 1996 Coast of Florida Study (COFS), Beach Fill with Periodic Renourishment is the Applicant’s Preferred Alternative. This alternative differs in several important respects from the Federal beach nourishment project identified in the COFS in length, hardground impacts, and expected renourishment interval. The Federal project evaluated in the COFS extended over 3.25 miles from DNR Monument R-116 to R-132, impacted 5.17 acres of nearshore hardbottom, and required a renourishment interval of four years. The Applicant's Preferred Alternative, which serves the same purpose as the Federal project, requires sand placement over only 1.9 miles of beach extending from DNR Monument R-116 to R-126, impacts 3.1 acres of hardbottom, and extends the renourishment interval to eight years. The Applicant’s Preferred Alternative significantly reduces environmental impacts relative to the Federal project proposed in the COFS by: (a) reducing impacts to hardbottom resources from 5.17 acres to 3.1 acres; (b) reducing the project length from 3.25 miles to 1.9 miles; and (c) reducing impacts associated with dredging events by extending the renourishment interval from four to eight years.

Section 3.0 of the FSEIS analyzes the potential impact of Applicant’s Preferred Alternative on the regional sediment transport conditions. Section 4.0 examines the environmental consequences of this alternative with respect to potential storm damage reduction benefits, recreational beach access, marine turtle nesting areas, and other parameters.

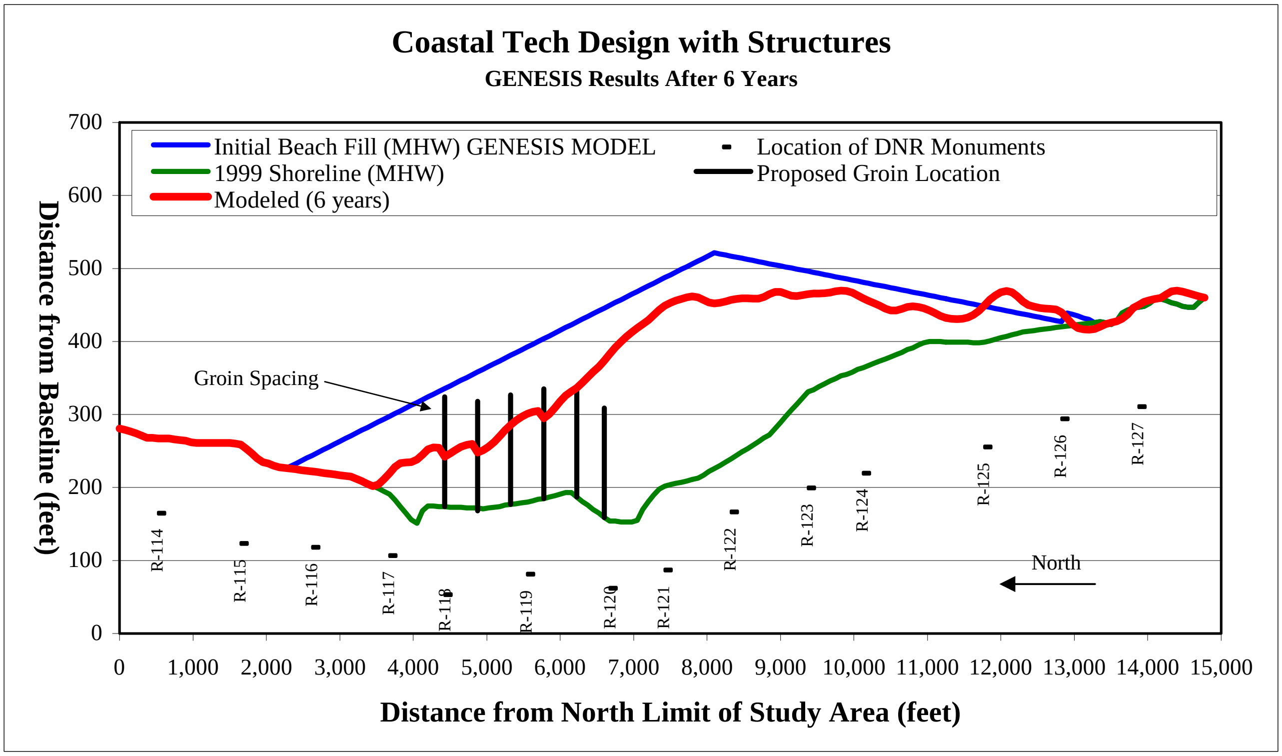
The key features of the Beach Fill with Periodic Renourishment Alternative are:

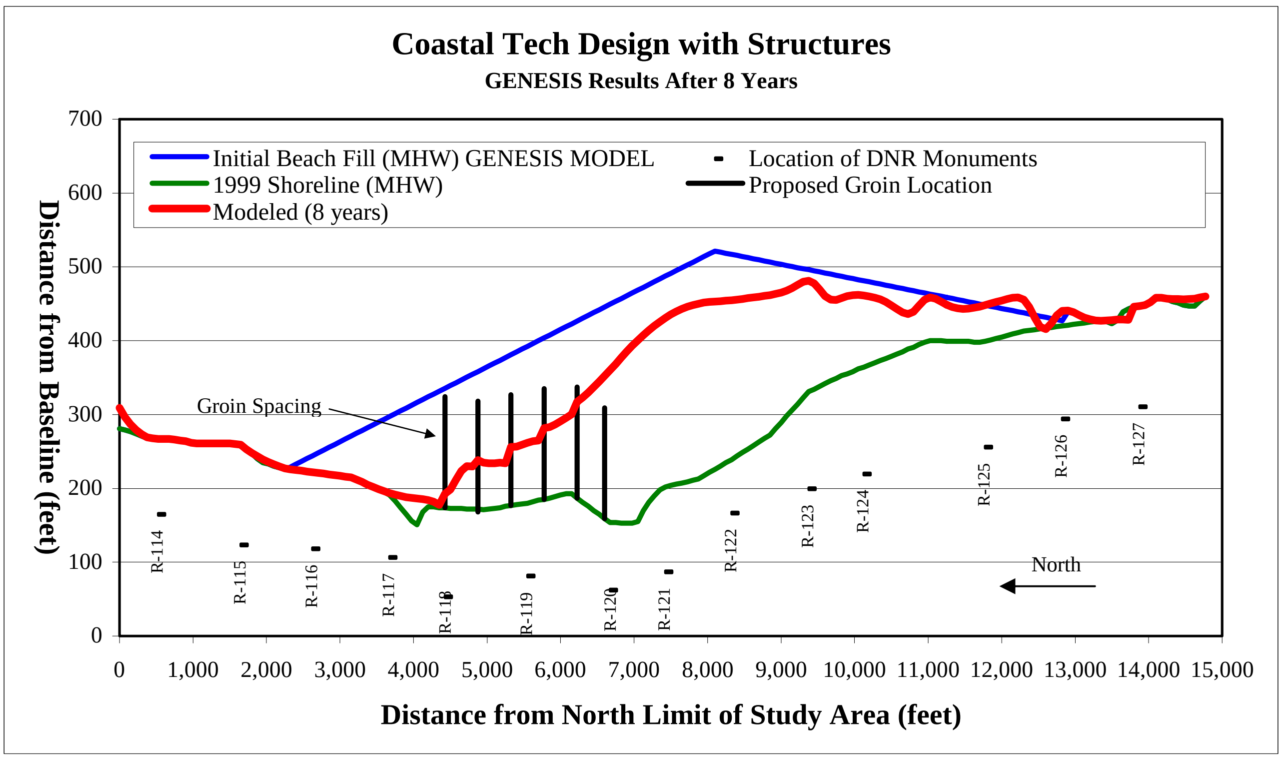
- Placement area 1.9 miles long from DNR Monument R-116 to R-126
- Placement volume of 1.5 million cubic yards of sand
- Berm elevation profile of +9 feet NGVD
- Berm width varying from 140 to 330 feet
- 3.1-acre mitigation reef to offset hardbottom impacts
- Renourishment interval of eight years
- Estimated cost of $9.3 million





Figures 2.4a & 2.4b





Figures 2.4c & 2.4d

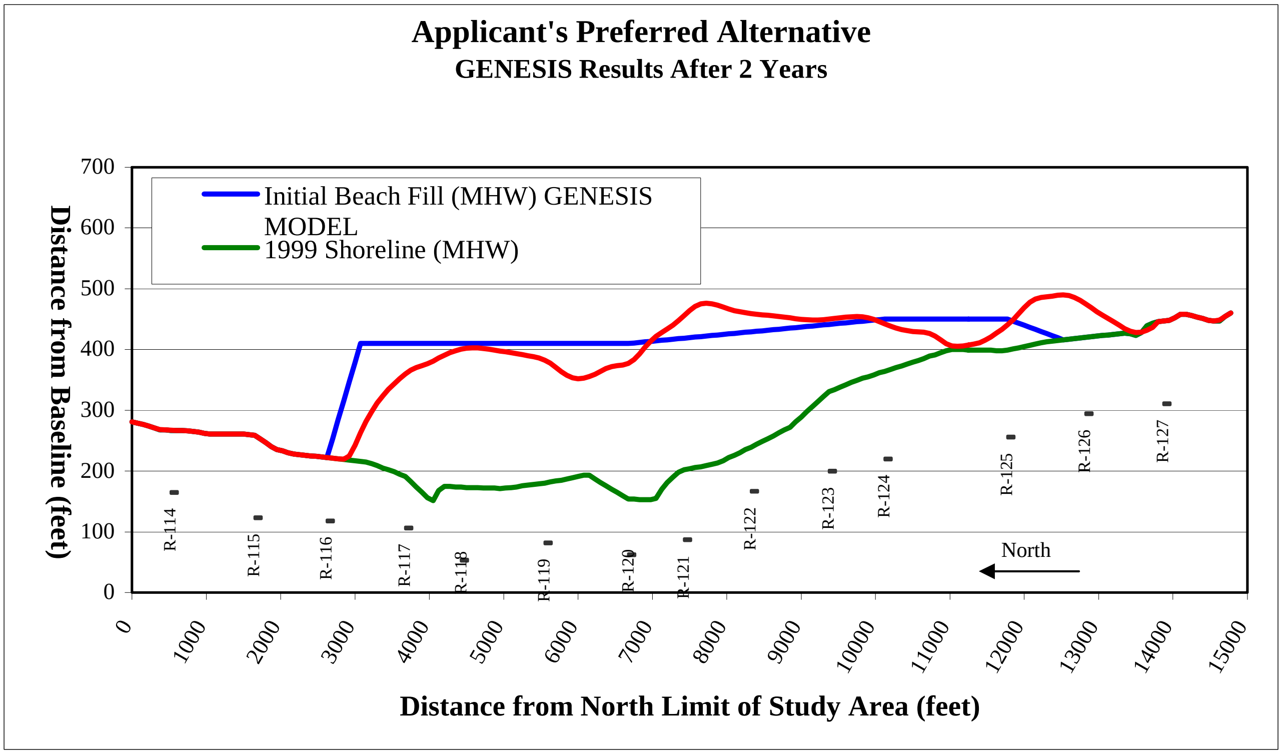
To improve Project performance over the eight-year renourishment interval, the design volume includes approximately 500,000 cubic yards of advance fill. To account for the longshore transport from north to south, the fill volume is not placed uniformly over the Project length from DNR Monument R-116 to R-126. Instead, the optimal project performance is achieved by placing a greater amount of the sand in the northern portion of the Project between DNR Monuments R-116 and R-122. This design offsets expected excessive losses at the northern portion of the Project (between DNR Monuments R-116 and R-119), extends the Project life, and provides for improved Project performance, compared to more uniform fill placement templates.

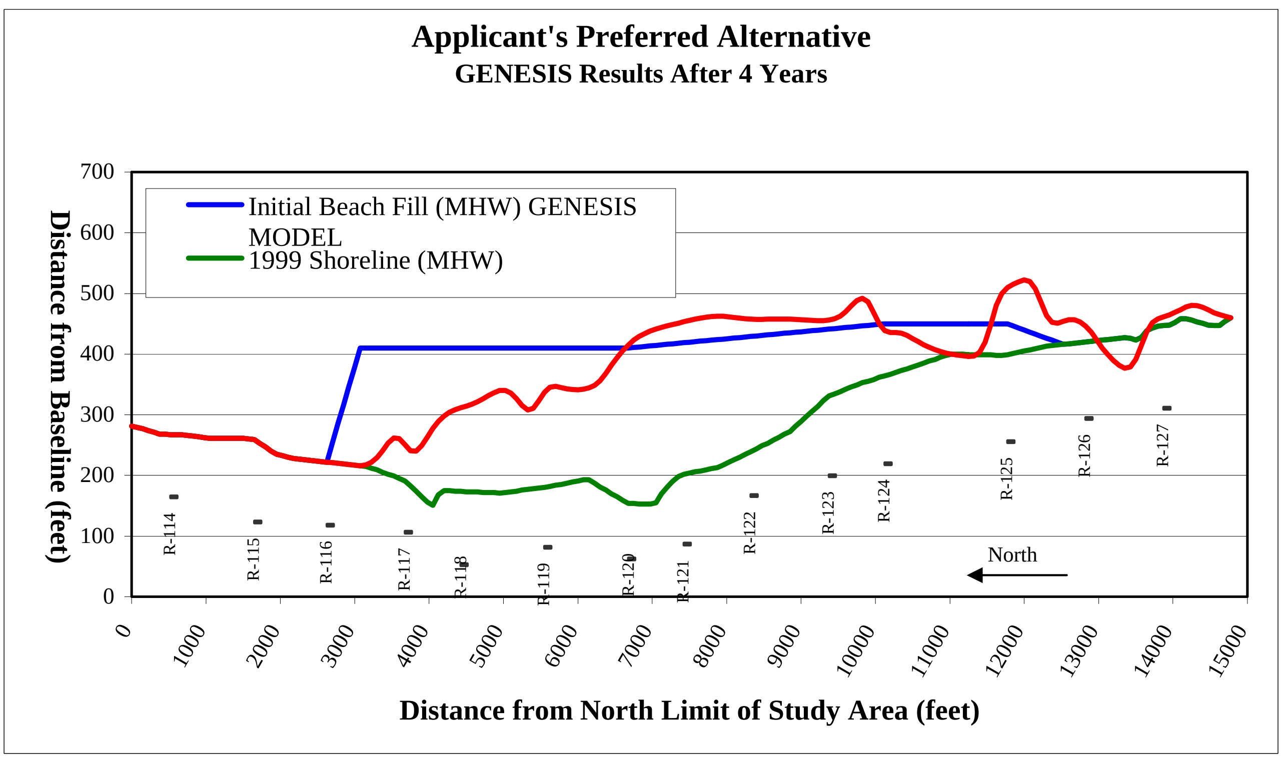
The predicted performance of the Applicant's Preferred Alternative was assessed using the GENESIS model. Model simulations were run to show fill performance at two-year intervals, from years two through eight. Figures 2.5a through 2.5d show the fill performance at years two, four, six and eight, respectively, following the initial placement.

The Applicant's Preferred Alternative satisfies the Project purpose and need. Six years after the initial placement, the shoreline is expected to erode back to the pre-fill condition between DNR Monuments R-116 and R-117, but not further due to the presence of the existing rock revetment and nearshore rock features along some segments of the shoreline. Eight years after the initial fill, the shoreline is expected to erode back to the pre-fill condition between DNR Monuments R-116 and R-118 (Figure 2.5d). The remainder of the Project Area shoreline would also suffer erosion losses, but not to the extent of the pre-fill shoreline conditions.

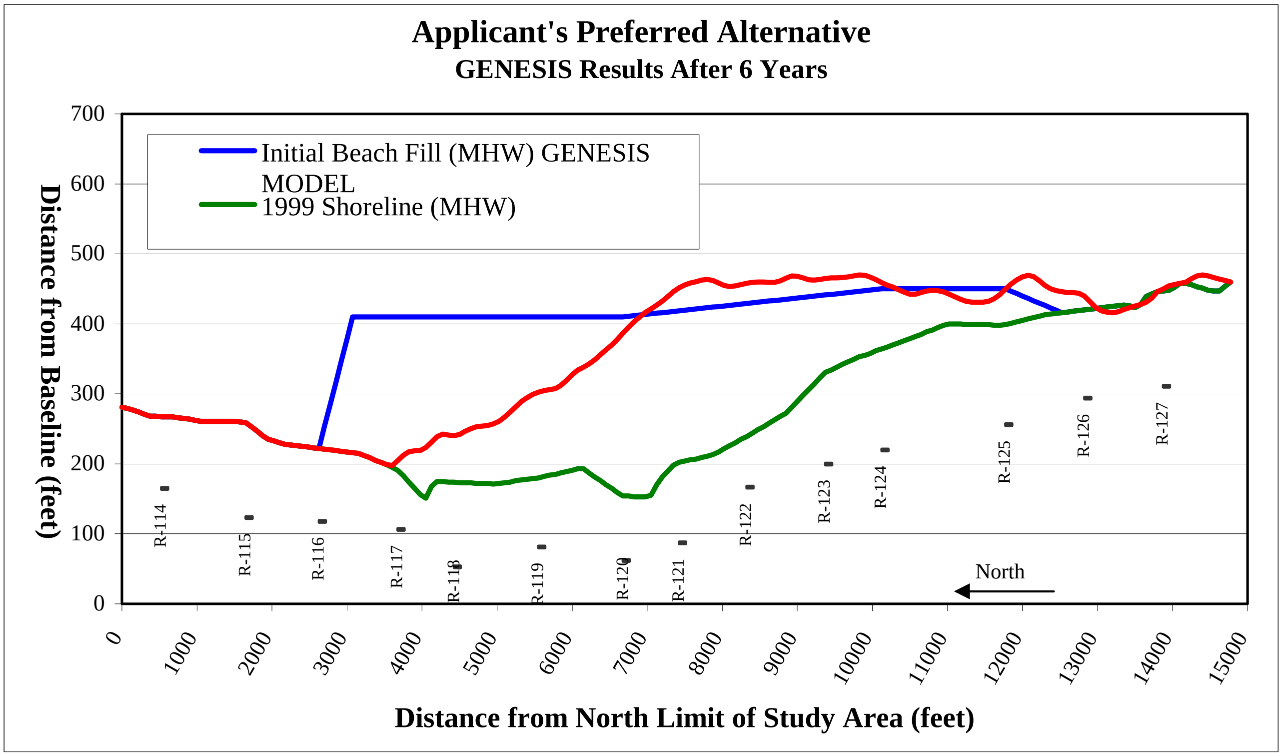
The Applicant's Preferred Alternative fully meets the Project goals and objectives between DNR Monuments R-116 and R-126 and, through construction of the mitigation reef, potential adverse environmental consequences of the Project are minimized and compensated. As analyzed in Section 2.3, other fill placement alternatives, such as extending the fill placement area north by 2,000 feet or reducing the fill placement area by half, do not significantly improve Project performance or reduce the potential impacts to nearshore hardbottom resources.

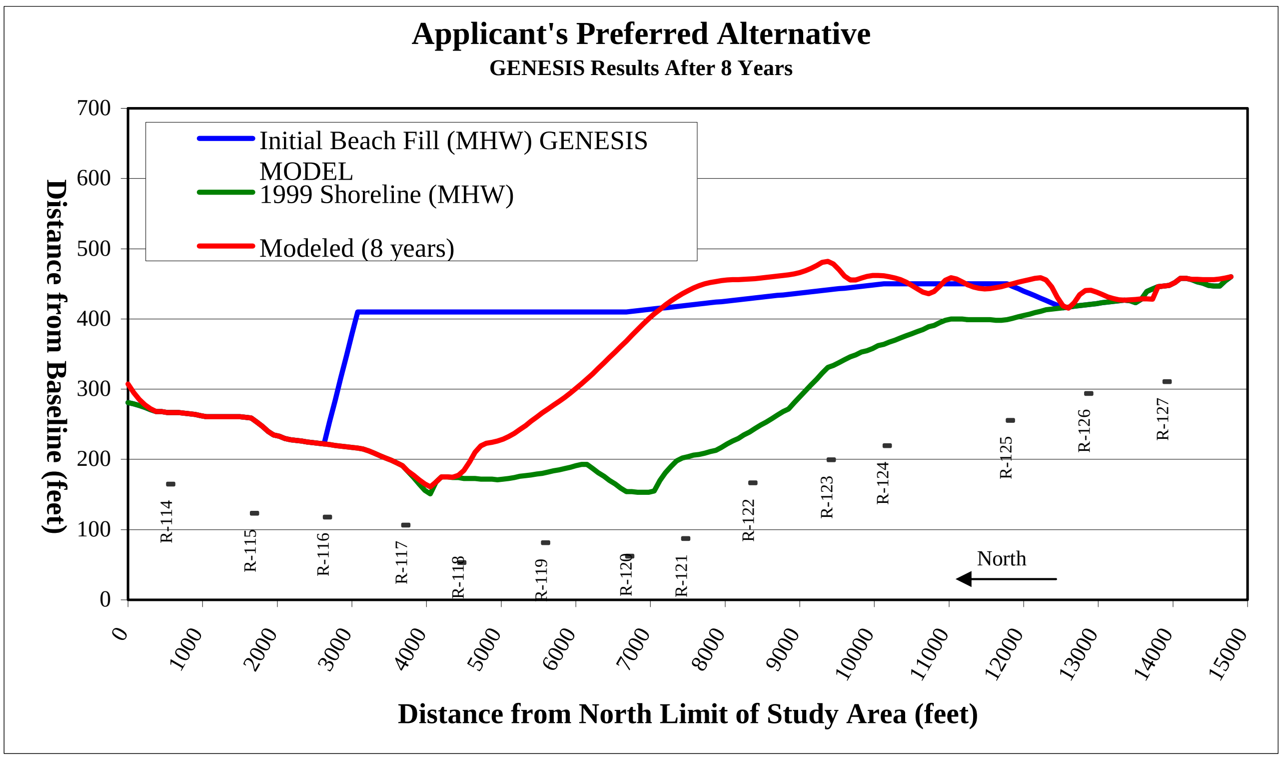
In addition to providing a sandy recreational beach, offsetting the downdrift impacts of Lake Worth Inlet and shoreline armoring, and enhancing marine turtle nesting areas, the Applicant's Preferred Alternative substantially reduces the risk of storm damage to upland structures in the Project Area. Appendix N includes the results of a "Storm Impact Risk Assessment" for the Project Area. Table 2.2a and Table 2.2b identify the specific structures that would be damaged under various return interval storm events (10, 20, 50 and 100-year storms) with the "No Action" Alternative and with the Applicant's Preferred Alternative.





Figures 2.5a & 2.5b





Figures 2.5c & 2.5d

Table 2.2a Number of Structures Impacted with "No Action" Alternative

Structure #	Description	Nearest Monument	Return Period Storm Impact							
			10-Year		20-Year		50-Year		100-Year	
			Method 1	Method 2	Method 1	Method 2	Method 1	Method 2	Method 1	Method 2
Total Number of Structures Impacted			0	2	3	7	5	15	5	19
1	Sloans Curve Townhouses	R-117								
2	2000 Condo Sloans Curve	R-117								
3	2000 Condo Sloans Curve	R-118								
4	2100 Condo Sloans Curve	R-118								
5	2100 Condo Sloans Curve	R-118								
6	2275 South Ocean The Reef Condo	R-120								
7	2275 South Ocean The Reef Condo	R-120								
8	2295 South Ocean Harbor House	R-120								
9	2295 South Ocean Harbor House	R-120								
10	2295 South Ocean Harbor House	R-120								
11	2320 South Ocean	R-121								
12	2330 South Ocean	R-121								
13	2340 South Ocean	R-121								
14	2500 South Ocean Condo	R-123								
15	2500 South Ocean Condo	R-124								
16	2545 South Ocean Palm Beach White House	R-124								
17	2565 South Ocean Palm Beach White House	R-124								
18	2580 South Ocean Stratford	R-124								
19	2600 South Ocean The 2600	R-124								
20	2600 South Ocean The 2600	R-124								
21	2660 South Ocean Beach Point	R-125								
22	2660 South Ocean Beach Point	R-125								
23	2660 South Ocean Beach Point	R-125								
24	2730 South Ocean Ambassador Hotel	R-125								
25	2770 South Ocean	R-125								
26	2770 South Ocean	R-125								
27	2774 South Ocean Ambassador South Cooperative	R-126								
28	2780 South Ocean Ambassador II Cooperative	R-126								

shaded box indicates storm impact

Table 2.2b Number of Structures Impacted with the Applicant's Preferred Alternative.

Structure #	Description	Nearest Monument	Return Period Storm Impact							
			10-Year		20-Year		50-Year		100-Year	
			Method 1	Method 2	Method 1	Method 2	Method 1	Method 2	Method 1	Method 2
Total Number of Structures Impacted			0	0	0	0	0	0	1	3
1	Sloans Curve Townhouses	R-117								
2	2000 Condo Sloans Curve	R-117								
3	2000 Condo Sloans Curve	R-118								
4	2100 Condo Sloans Curve	R-118								
5	2100 Condo Sloans Curve	R-118								
6	2275 South Ocean The Reef Condo	R-120								
7	2275 South Ocean The Reef Condo	R-120								
8	2295 South Ocean Harbor House	R-120								
9	2295 South Ocean Harbor House	R-120								
10	2295 South Ocean Harbor House	R-120								
11	2320 South Ocean	R-121								
12	2330 South Ocean	R-121								
13	2340 South Ocean	R-121								
14	2500 South Ocean Condo	R-123								
15	2500 South Ocean Condo	R-124								
16	2545 South Ocean Palm Beach White House	R-124								
17	2565 South Ocean Palm Beach White House	R-124								
18	2580 South Ocean Stratford	R-124								
19	2600 South Ocean The 2600	R-124								
20	2600 South Ocean The 2600	R-124								
21	2660 South Ocean Beach Point	R-125								
22	2660 South Ocean Beach Point	R-125								
23	2660 South Ocean Beach Point	R-125								
24	2730 South Ocean Ambassador Hotel	R-125								
25	2770 South Ocean	R-125								
26	2770 South Ocean	R-125								
27	2774 South Ocean Ambassador South Cooperative	R-126								
28	2780 South Ocean Ambassador II Cooperative	R-126								

shaded box indicates storm impact

With the Applicant's Preferred Alternative in place, the number of structures likely to be damaged in a 100-year return interval storm, as analyzed under Method 2, would drop from 19 damaged structures to 3, a six-fold reduction in expected storm damage. For a 50-year return interval storm, the storm reduction benefits are equally dramatic, as all 15 structures expected to be damaged without the project would be protected by the Applicant's Preferred Alternative. Likewise, all seven structures that would otherwise be damaged without the Applicant's Preferred Alternative are expected to avoid all damage with the preferred project in place. While the storm damage reduction benefits are less impressive when analyzed under Method 1, the reduction in damage remains significant because the size and value of the condominium structures impacted.

As discussed in Section 2.1.1, the predicted storm damage presented in Appendix N and discussed here is more conservative than the damage that would be expected if the analysis were based on the model predictions used to establish the CCCL.

Finally, as discussed in Section 4.0, restoration of the beach in the Project Area will unavoidably impact a total of 3.1 acres of nearshore hardbottom resources immediately adjacent to the shoreline. Even if the fill placement area and volume are reduced by half, the extent of impact to nearshore hardbottom resources would not be substantially reduced due to spreading of the fill along the Project Area shoreline (<u>see</u> Section 2.3.2, Reduced Fill Area Design Alternative). As evaluated in Appendix M, T-Head Groin and Reduced Fill Alternative, limiting the fill volume and placement area can reduce hardbottom impacts, however, not without significantly increasing the adverse impacts associated with more frequent renourishment events.

To mitigate the unavoidable impact to hardbottom resources, the Applicant's Preferred Alternative includes construction of a 3.1-acre mitigation reef six months in advance of the fill placement, as described in Appendix E, Mitigation Reef Plan and Monitoring Program.

2.1.4 Sand Source Alternatives Analysis

The Applicant investigated several alternative sand sources, including offshore borrow areas relatively close to shore, deep water sources further offshore, upland, and foreign sand sources. Other potential sources of fill material were also examined and are described below.

2.1.4.1 Offshore Borrow Areas (Applicant's Preferred Sand Source)

The Applicant conducted extensive investigations of the offshore region from Lake Worth Inlet south 12.5 miles to the Town of South Palm Beach (CPE, 2000). Investigations were conducted within two (2) nautical miles of the shoreline and included bathymetric surveys, seismic surveys, side scan surveys, jet probes, vibracores, and cultural resource investigations. As identified in

Figure 2.6, seven (7) potential offshore borrow areas have been delineated from these investigations. Every potential borrow area consists of a mixture of relict and modern marine sand, deposited during the Holocene marine transgression. The sand deposits are all located on a shallow terrace or shelf in 30 to 50 feet of water. Borrow area sands have accumulated upon the terrace in a depression created by the presence of two inner shelf limestone outcrops. The terrace narrows towards the south, causing the offshore margin of the basin to converge upon the shoreline.

Two bedrock features rim the depositional basin and are composed of biogenic Pleistocene (Anastasia Formation) limestone and provide an ideal substrate for marine benthic communities. In the nearshore, extensive hardbottom habitat has formed upon the limestone, while modern coral reef communities have colonized the offshore bedrock outcrops. The offshore rim has been partially investigated and been found to be biologically productive (CSA, 2000a). These two rim features provide a source of coarse sand and gravel-sized sediment that has been identified in all of the potential offshore borrow areas. Analysis of vibracore logs suggests the abundance of limestone clasts (a.k.a. intraclasts), coral fragments, or coarse shell debris is a function of proximity to hardbottom. The offshore reef along the seaward rim is probably a more significant sediment source because it lies along the seaward margin of the basin and is subject to a stronger wave climate induced by seasonal storm activity.

Construction by hopper dredge was specifically eliminated from consideration to avoid potential impacts to biological communities in the offshore reef along the seaward rim; therefore, construction by hydraulic dredge is proposed from borrow areas III and IV – the Applicant's Preferred sand source. Appendix G, Vessel Operations Plan, describes the conditions and restrictions governing the dredging of the Applicant's Preferred borrow areas as contained in the Joint Coastal Permit issued by FDEP for the Project. The plan includes a 400-ft no dredge buffer and a 200-ft no anchor buffer to avoid and minimize impacts to hardbottom resources in the vicinity of the borrow areas.

Sand from the preferred sand source is best described as a gray, well-sorted mixture of quartz and carbonate sand, with trace silt content. The composite mean grain size is 0.32 mm and 0.22 mm for Borrow Areas III and IV respectively. Silt content, also derived from composite sample analysis, shows that Borrow Area III has a silt content of 1.5% and Borrow Area IV has a silt content of 2.9%. The sediment characteristics vary only slightly with depth. The material considered for inclusion in the borrow areas are consistent and typical of sand routinely utilized for nourishment in Florida. Appendix L includes the FDEP Permit for the Phipps Project with the borrow area cross-sections that document that the cores extend to the planned depth of dredging. Appendix K includes geotechnical information for each borrow area and for representative strata in each core in each borrow area. Coarse sand and gravel content is generally less than 7%. Vibracore logs (CPE, 2000) indicate the presence of this coarse gravel and cobble in direct proportion to the proximity to hardbottom. A *Supplemental Geotechnical Analysis* (Coastal Tech, 2000d; Appendix K) determined the content of coarse gravel and cobble to be 0.3% for Borrow Area III and 0.2% for Borrow Area IV.

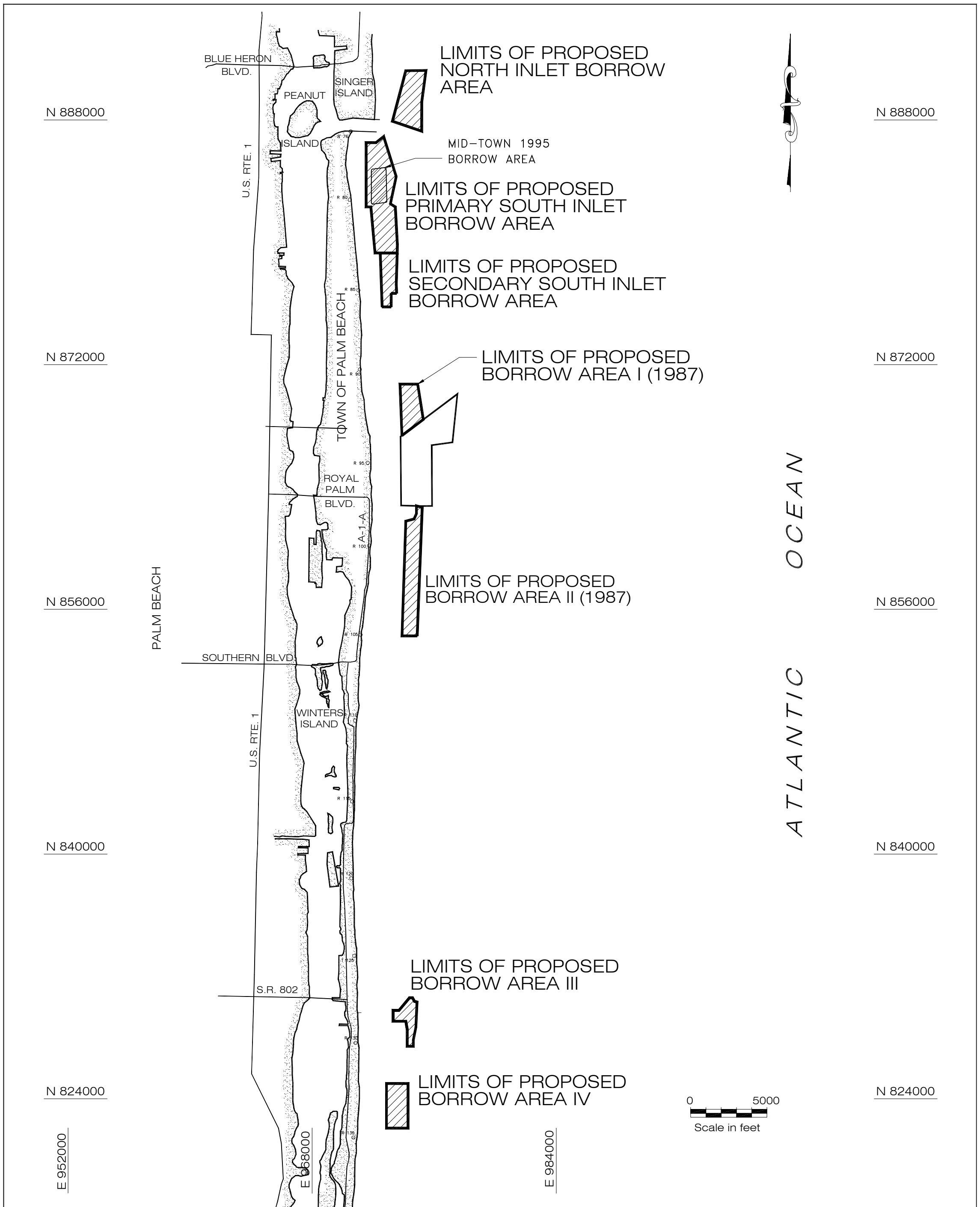


Figure 2.6 Seven Potential Offshore Borrow Areas

Fill material derived from an offshore borrow area may cause some temporary water quality and hardbottom habitat degradation due to turbidity caused by the presence of fines. In general, the State of Florida has accepted that fill material with a percent of fines at 5% or less will not have a significant impact upon ambient water quality. Sand fill obtained from the preferred sand source contains less than 3% fines and is not expected to significantly affect water quality.

The sedimentology of the proposed offshore borrow areas is relatively uniform. Significant changes in compatibility, water quality, or habitat degradation are not expected through the selection of a specific area or cut.

The preferred sand source includes two sites (Borrow Areas III and IV) approximately 3,500 feet offshore and located between 1.5 and 2.6 miles south of the fill area (Figures 2.7 and 2.8). The preferred sand source is compatible with the native beach sand; this is addressed in greater detail in Section 3.3 of this FSEIS.

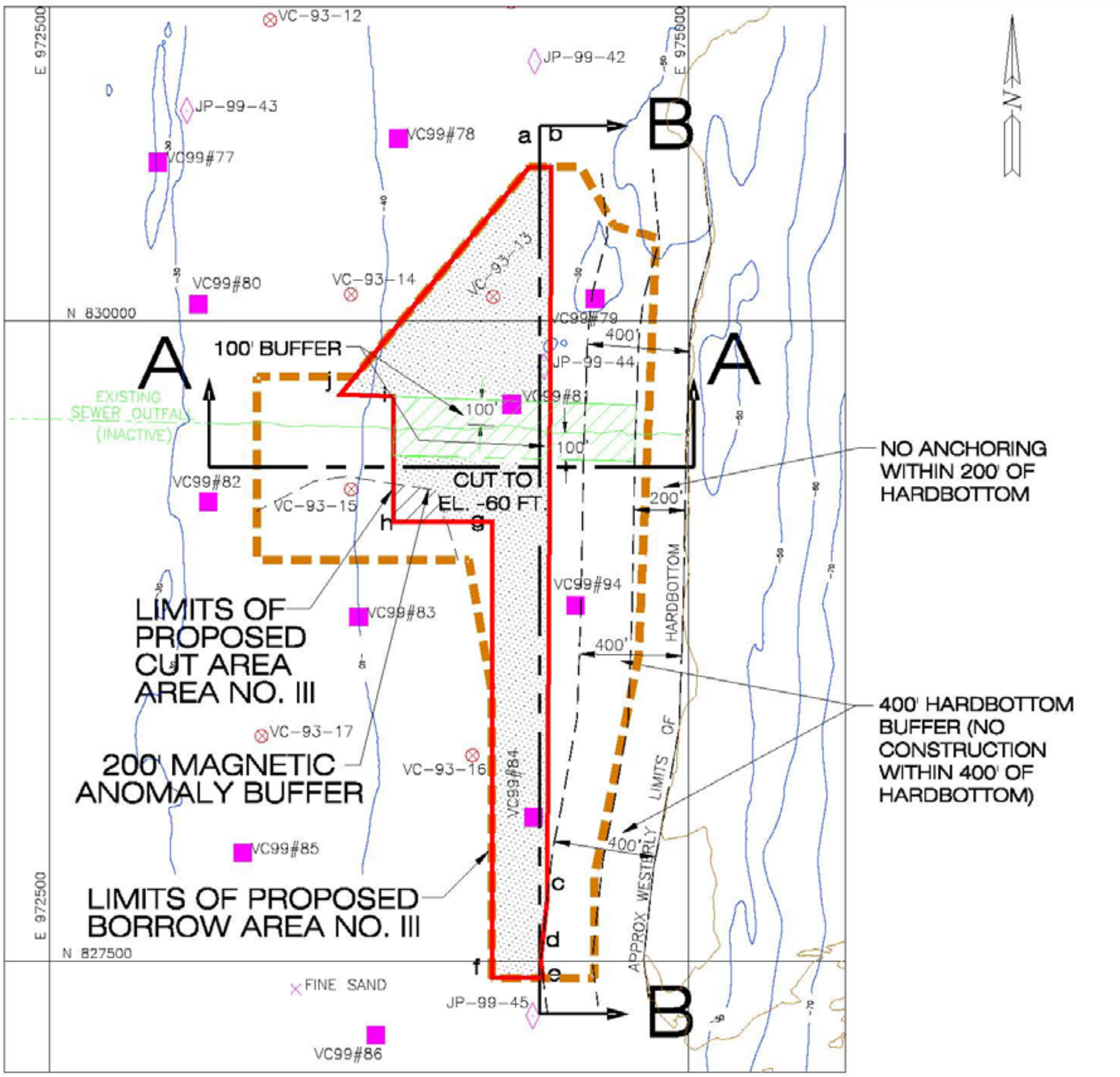
2.1.4.2 Deep Water Sand Sources

The vast majority of offshore borrow areas are sited in relatively shallow water depths less than 100 feet. These shallow water sand sources are economically extracted using widely available technologies. Recovering sand from borrow areas located in water depths in excess of 100 feet requires the utilization of specialized equipment not readily available and can significantly increase Project costs.

Deep-water sand sources are not expected to be routinely targeted for dredging until the inventory of shallow-water borrow areas has been exhausted. During this review, no projects were identified from which information on the location, quantity, suitability, cost, or environmental impacts of deep water sand sources could be extracted. This type of information will become available with the decline in shallow water reserves. However, it is unlikely that deep-water sand source information will be available for consideration during the planning and construction of the proposed Project.

2.1.4.3 Upland Sand Sources

Upland sand source areas are generally confined to sand pits or mines currently producing material that may be compatible with native beaches. The largest reserves are located in the Central Highlands physiographic region of peninsular Florida and include the Lake Wales Ridge. Additional sand deposits are associated with other relatively high relief (+50 ft) relict coastal features in the Coastal Lowlands physiographic region. These include the Ten Mile Ridge and Atlantic Coastal Ridge. Numerous small mining operations also extract Cenozoic marine sands from the low-relief areas within this physiographic region.



NOTES:

1. EXISTING CONDITIONS AND DATA FROM DRAWINGS BY COASTAL PLANNING & ENGINEERING (CP&E)
2. DATE OF BATHYMETRIC SURVEY: OCT. 30 – NOV. 6, 1998
3. COORDINATES SHOWN HEREON ARE BASED ON FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, 1983/90 NAD.
4. ELEVATIONS SHOWN HEREON ARE IN FEET BASED ON NATIONAL GEODETIC VERTICAL DATUM, 1929.
5. OUTFALL LOCATION PROVIDED BY CP&E DRAWING (LOCATED FROM SEISMIC DATA WITHIN THE BORROW AREA).
6. 200 FOOT BUFFER FOR MAGNETIC ANOMALIES HITS ARE FROM A DRAWING BY CP&E.

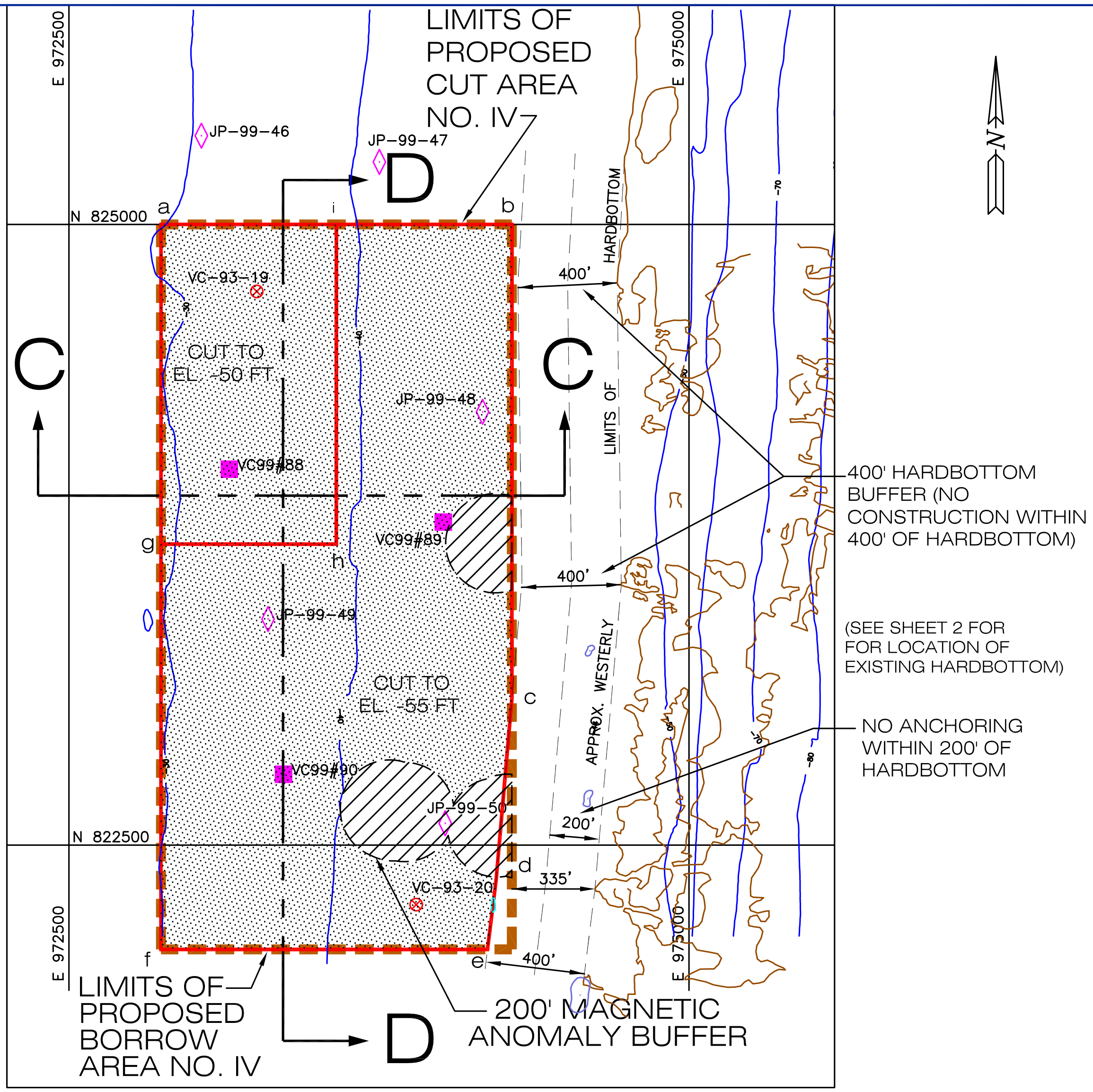
LEGEND:

VC99#1 DENOTES 1999 CPE VIBRACORE LOCATION
VC-93-18 DENOTES 1993 PALM BEACH CO. VIBRACORE LOCATION
JP-99-45 DENOTES 1999 CPE JET PROBE LOCATION
DENOTES 1998 CP&E HARDBOTTOM

Cut Area Coordinates

Point	x	y
a	974,377.66	830,601.23
b	974,463.53	830,601.23
c	974,446.71	827,739.38
d	974,421.27	827,504.36
e	974,430.20	827,433.79
f	974,231.84	827,433.79
g	974,231.84	829,213.76
h	973,846.80	829,213.76
i	973,846.80	829,704.77
j	973,638.02	829,712.53

Figure 2.7 Borrow Area III



NOTES:

1. EXISTING CONDITIONS AND DATA FROM DRAWINGS BY COASTAL PLANNING & ENGINEERING (CP&E)
2. DATE OF BATHYMETRIC SURVEY: OCT. 30 – NOV. 6, 1998
3. COORDINATES SHOWN HEREON ARE BASED ON FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, 1983/90 NAD.
4. ELEVATIONS SHOWN HEREON ARE IN FEET BASED ON NATIONAL GEODETIC VERTICAL DATUM, 1929.
5. 200 FOOT BUFFER FOR MAGNETIC ANOMALIES HITS ARE FROM A DRAWING BY CP&E.

LEGEND :

VC99#1 DENOTES 1999 CPE VIBRACORE LOCATION
VC-93-18 DENOTES 1993 PALM BEACH CO. VIBRACORE LOCATION
JP-99-45 DENOTES 1999 CPE JET PROBE LOCATION
DENOTES 1998 CP&E HARDBOTTOM
DENOTES 2002 DCA HARDBOTTOM

Cut Area Coordinates

Point	x	y
a	972,871.09	825,000.00
b	974,286.09	825,000.00
c	974,286.09	823,092.25
d	974,223.29	822,367.07
e	977,187.74	822,079.62
f	972,871.09	822,079.62
g	972,871.09	823,712.25
h	973,578.15	823,712.25
i	973,578.15	825,000.00

Figure 2.8 Borrow Area IV

The material from upland sand mines consists of medium to fine grained quartz sand with trace (<5 wt%) fine and organic content. Mean-grain size can be expected to range between 0.50 millimeter and 0.30 millimeter. Subjected to extensive chemical weathering, upland sand deposits are composed of nearly pure quartz, with carbonate or shell content typically less than a few percent.

These data indicate upland sands are texturally compatible to the native beaches of southeast Florida. However, the shell content of south Florida beaches is generally in excess of 25% and at some localities the beach sand consists entirely of shell material. The upland sand sources are therefore not generally compatible to south Florida beaches with regard to mineralogy or composition. The impact of these distinctions is perhaps most significant to the ecological function of a beach. Altering the mineralogy might potentially affect marine turtle nesting density and hatching success by changing the temperature, moisture content and/or hardness of a nesting beach.

Additional ecological impacts may occur at the site of upland sand source recovery, especially if it is located upon one of the peninsula’s sand ridges. Florida’s sand ridges are relict marine terrace or shoreline features that formed in association with one of many sea-level highstands. Today, the Lake Wales Ridge, Ten Mile Ridge, and Atlantic Coastal Ridge generally host Florida scrub or flatwood plant communities. These communities often support threatened and endangered species that may be impacted by the development or expansion of an upland mine.

In addition to potential ecological effects, utilization of an upland sand source may also impact an area’s infrastructure during transportation from the mine to the Project location. Historically, overland transportation of beach fill has been achieved using dump trucks. Significant adverse impacts associated with this type of transportation can be expected, including degradation of the structural integrity of roads and buildings, reduction in traffic safety and air quality, and increased noise pollution. Establishing trucking weight limits can mitigate potential damage to infrastructure; however, the number of truckloads required to place the fill volume would increase substantially. For example, at a reduced load of 10 cubic yards per haul, the proposed 1.5 million cubic yard nourishment Project will require approximately 150,000 truck loads of sand be driven through the Town of Palm Beach. To reduce potential construction delays and control costs, trucking on this scale would most likely be continuous, causing substantial disruption of local traffic patterns and great inconvenience to the general public.

The broad spectrum of adverse impacts created by the use of an upland sand source is not justified by the minor benefits generated from the selection of this alternative. The "Comprehensive Coastal Management Plan Update, Palm Beach Island, Florida" (ATM, 1998), similarly concluded that, "The unit costs and impact to infrastructure (roads) associated with truck hauling to the Project Area make this alternative not viable …" for the quantities needed to restore the beach within the Project Area.

2.1.4.4 Foreign Sand Sources

Potential sand sources have been identified throughout the wider Caribbean region, including coastal and offshore deposits located in the Bahamas and Turks & Caicos. The sand consists of biogenic carbonate (i.e. shells) and physiochemical precipitates (i.e. oolite) generally located in subtidal, high-energy areas. The depositional environment produces smooth, well-worn sand grains with a mean grain size between 0.25 millimeter and 0.75 millimeter. The wave-dominated environment generally precludes the accumulation of fines, so deposits contain only trace amounts of silt and clay.

The textural features of Caribbean marine sands are compatible with the native beaches of southeast Florida and the content of fines would cause minimal turbidity during construction. However, there remain questions and uncertainties regarding the potential formation of beach rock and alterations to the physical environment of marine turtle nesting beaches. Oolitic sands are composed of aragonite, a common marine mineral that is soluble in seawater. Under arid climatic conditions, aragonite sands will rapidly (months to years) lithify to form beach rock at or very near (i.e. inches to feet) the surface. In addition, the mono-mineralic foreign sand has a distinct heat capacity that may alter the *in situ* temperature of a marine turtle nesting beach.

Additional considerations regarding the logic in using foreign sand deposits to nourish Florida's unstable beaches includes the distinct shape and specific gravity of aragonite sand, either of which may change hydraulic behavior of this sediment. Finally, the potential presence of exotic organisms on foreign sand cannot be overlooked.

The USACE, in consultation with the U.S. Fish & Wildlife Service (USFWS), FDEP, and Miami-Dade County Department of Environmental Resources Management (DERM) have begun tests to determine the potential impacts of foreign carbonate sand on the physical and biological conditions of a native beach. A pilot project was completed at Fisher Island; however, the large-scale and repeated use of Caribbean sands is not considered appropriate at this time.

2.1.4.5 Inlet By-Pass Sand Sources

The Lake Worth Inlet shoal complex includes both flood and ebb sand deposits. The sediment in these formations has been examined as a potential sand source because it is derived directly from the native beach via the interaction of longshore current and tidal flow. Flood shoal sediments generally accumulate in sensitive marine habitat or navigable waterways, complicating their use as a sand source for beach nourishment. In addition, the volume of available material is generally less than 0.5 million cubic yards.

The ebb shoal complex has been previously investigated and subdivided into a northern and southern area. The complex consists of sand with a mean grain size of approximately 0.25 millimeter to 0.30 millimeter, with trace silt content. Coarse sand, shell, and coral fragments were identified in both areas. Submarine cementation was encountered at distinct elevations in both the northern and the southern areas as well.

The Lake Worth flood shoal is not considered as a realistic option because it is small and located within sensitive marine habitat. The ebb shoal complex does not appear to be a viable alternative either. The presence of coarse sand, shell, and coral fragments are aesthetically undesirable and may potentially be problematic to nesting marine turtles. In addition, beach rock has also been documented in both the northern and southern areas, although the south shoal area was used as fill in conjunction with the Mid-Town Project.

Another related but undermined potential sand source at Peanut Island has been identified by the USACE, Jacksonville District and is described in the "Draft Environmental Assessment, Change in Maintenance Operations at Palm Beach Harbor and Peanut Island, Palm Beach County, Florida" (September 2000). According to the EA, Peanut Island is a 79-acre island formed through the placement of dredged material over the last 80 years during the creation and maintenance of the Intracoastal Waterway (IWW), Lake Worth Inlet and Palm Beach Harbor. Under the proposed plan, the dredge disposal site on the southern end of Peanut Island would be offloaded of the material stockpiled there and placed into one of three new disposal areas: (1) near-shore disposal area south of Lake Worth Inlet south jetty, (2) Mid-Town Beach, or (3) the "anoxic hole" adjacent to the City of Lake Worth Municipal Golf Course. The third alternative is the least cost option and, while no final disposal option has been selected, appears to be the most viable.

The dredged material placement option closest to Peanut Island is the beach south of Lake Worth Inlet. Using a conventional dredge pipeline, the District has determined that this beach area could accommodate 600,000 cubic yards of dredged material from the Peanut Island disposal site. The Mid-Town Beach site could also accommodate 600,000 cubic yards of material, beginning south of the Breakers Hotel and continuing south for approximately 2.25 miles.

The District did not evaluate potential placement of the Peanut Island material on Phipps Ocean Park Beach or determine the potential hardbottom impacts of placement south of Lake Worth Inlet or on the Mid-Town Beach. However, placement of an additional 600,000 cubic yards of sand south of Lake Worth Inlet is unlikely to impact the rate of erosion or shoreline change conditions in Phipps Ocean Park over the long-term.

2.2 Issues and Basis for Choice

2.2.1 Project Alternatives

The alternatives were evaluated based on analyses of accomplishment of the Project purpose and need, historic shoreline trends, numerical modeling, and effects on the environment. Specific factors used as a basis for choice of the Applicant's Preferred Alternative include hardbottom and reef impacts, sea turtle nesting and foraging habitat, public recreation, sediment budget restoration, and public safety (see Section 1.9.2). The Applicant's Preferred Alternative is technically and economically feasible and best achieves the Project purpose with the least detrimental environmental consequences.

2.2.2 Sand Source Alternatives

The alternative sand sources were evaluated based on an analysis of the quantity and quality of available sand, economic and technical feasibility of the source, and the potential environmental consequences of utilizing the sand source.

2.3 Alternatives Eliminated From Detailed Evaluation

This section describes other alternatives within the jurisdiction of the lead agency that may partially achieve the purpose and need of the Project, but that were eliminated from detailed consideration. In general, alternatives were eliminated from detailed discussion if they were either not technically or economically feasible or if they failed to adequately achieve the Project purpose or need. In addition, this section describes alternatives evaluated and eliminated during the FDEP permitting process such as installation of a Prefabricated Erosion Prevention (PEP) reef, installation of groins (without beach fill), and modification of the Lake Worth Inlet sand transfer plant. Finally, this section advances the alternatives described and considered in the COFS (October 1996).

2.3.1 Alternative 4 - Increased Fill Area Design (Placement of additional 343,200 cubic yards between DNR Monuments R-114 and R-116):

The Increased Fill Area Design Alternative would extend the fill area 2,000 feet further north of the Applicant's Preferred Alternative to include the area between DNR Monuments R-116 and R-114. Fill placed in the area north of the Applicant's Preferred Project Area would potentially serve as a feeder beach and could be expected to improve the Project performance or extend the Project life.

If the Project is expanded 2,000 feet north to DNR Monument R-114, the total Project length would increase from 1.9 to 2.33 miles and the total fill volume would increase from approximately 1.55 million to 1.89 million cubic yards, or 343,200 cubic yards more than the Applicant's Preferred Alternative (see Table 2.3). Consistent with the Applicant's Preferred Alternative, between DNR Monuments R-114 and R-116, the average sand placement rate would be 172 cubic yards per foot. Applying the same design principles as the Applicant's Preferred Alternative, fill performance is expected to require renourishment every eight years. Thus, the remaining sand quantity prior to each maintenance event is approximately equal to the 15-year design storm event, the minimum buffer necessary to protect upland areas.

Higher sand placement quantities in the beach fill template associated with this alternative would be expected to result in greater coverage of nearshore hardbottom and possible sedimentation of sea turtle feeding areas and interstitial spaces in the nearshore reef structure (see Figure 2.9). In addition, this alternative would be expected to require a longer construction window to accomplish the initial restoration. Cumulative impacts to sea turtle nesting in the seasons following Project construction would be reduced due to a longer renourishment interval.

Table 2.3 Alternative 4 - Increased Fill Design Characteristics				
	Fill Density			
Reference Monument	**@ Mon. (cy/ft)**	**Mean (cy/ft)**	**Distance (ft)**	**Volume (cy)**
R-114	4	70	1,000	70,160
R-115	136	154	1,000	153,950
R-116	172	172	1,040	178,880
R-117	172	172	730	125,560
R-118	172	190	1,179	223,892
R-119	208	236	1,106	261,514
R-120	265	254	722	183,532
R-121	244	227	945	214,799
R-122	211	180	1,022	183,449
R-123	148	125	985	123,371
R-124	102	90	1,490	134,026
R-125	78	39	1,088	42,214
R-126	0	0	0	0
		Totals:	12,307 ft	1,895,347 cy
			Total Preferred Fill Volume	**1,552,147**
			Total Increased Fill Volume	**343,200**

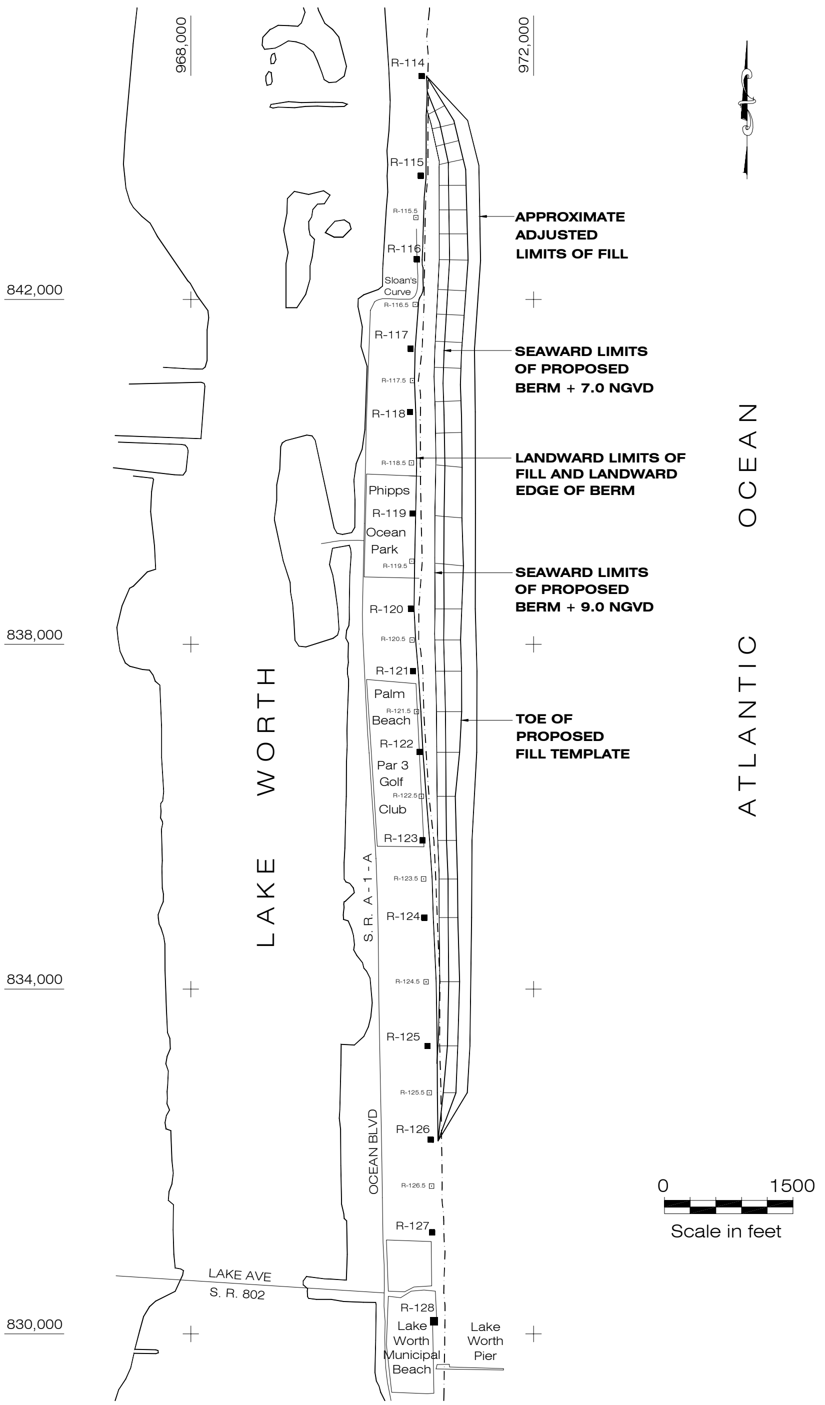


Figure 2.9 Increased Fill Area Design

The total estimated construction cost for the Increased Fill Alternative is $12 million. This alternative is expected to adversely impact an additional 2.9 acres of high quality nearshore reef in water depths ranging from -9.6 feet to -14 feet. The types of hardbottom present in the nearshore Project Area are described in detail in Section 3.7. Based on aerial photography, it is apparent that extensive nearshore reef exists from DNR Monument R-114 to R-116, and if the fill area were expanded north, it would substantially increase the impact to these resources. Therefore, Alternative 4 was eliminated from consideration as a viable alternative.

2.3.2 Alternative 5 - Reduced Fill Area Design (Placement of 750,000 to 1.5 million cubic yards between DNR Monuments R-116 and R-121)

Ideally, the Reduced Fill Area Design Alternative would be one that avoids entirely the direct burial of any nearshore hardbottom resources. This is not possible, due to the extensive nearshore hardbottom features that currently exist throughout the Project Area; however, this alternative reduces the fill placement area by 50% and the initial fill placement volume by up to 50%.

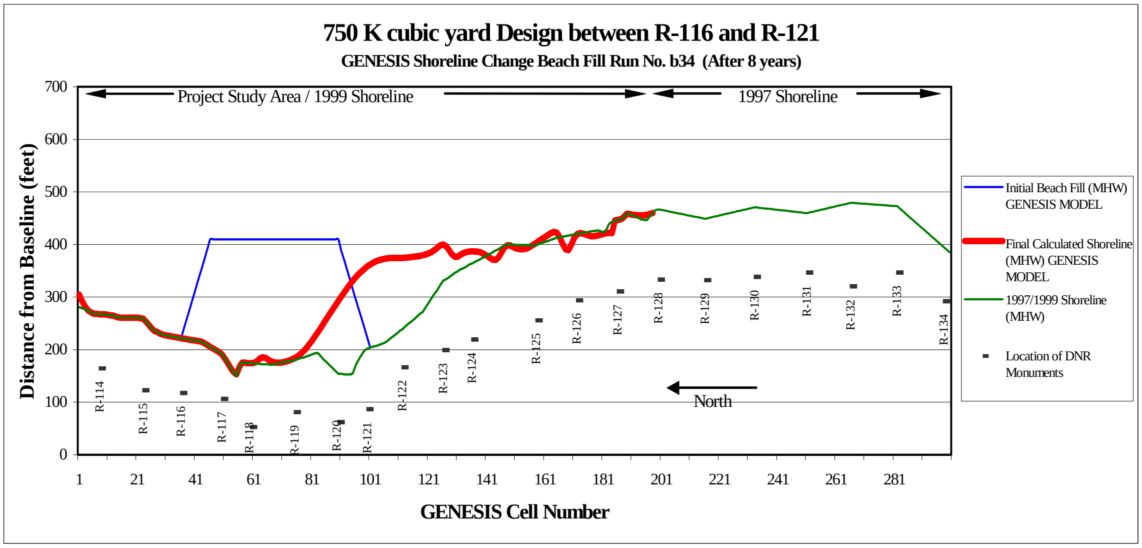
The evaluation of the Reduced Fill Area Alternative assumed three initial fill placement volumes (750,000, 1.13 million and 1.5 million cubic yards), all placed between DNR Monuments R-116 and R-121 (Figure 2.10). These scenarios all reduce the Applicant's Preferred Alternative from approximately 10,000 to 5,000 feet in length. Because of the shorter project length for the Reduced Fill Area Design alternative, the design fill template would extend from 300 to 550 feet seaward of the line of mean high water, depending on the total sand volume placed. In comparison, the approximate Mean High Water Line (MHWL) of the Applicant's Preferred Alternative fill template extends seaward between approximately 190 to 380 feet.

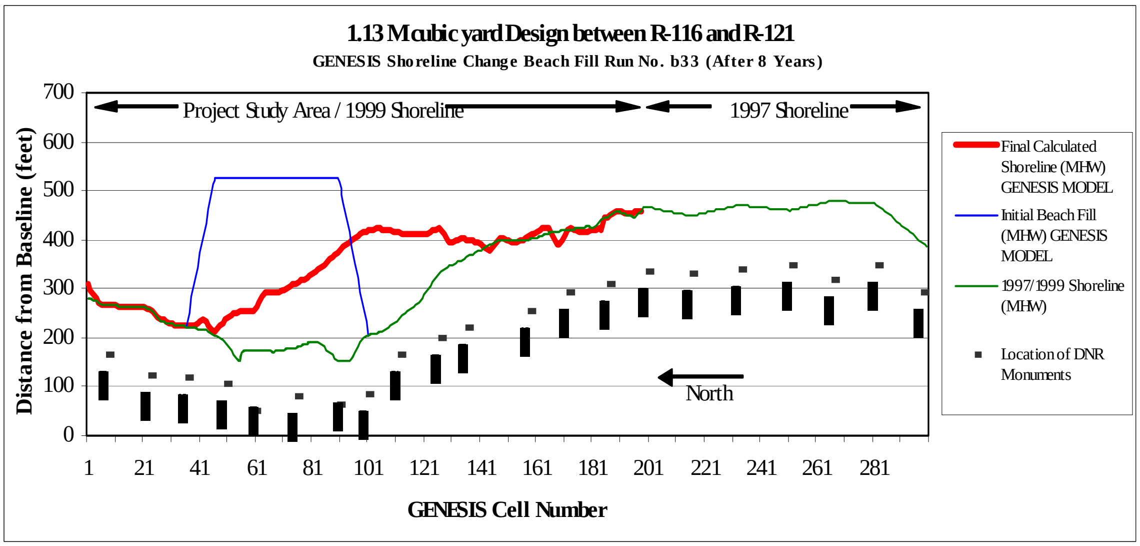
For all three fill placement volumes, the GENESIS model runs showed that the fill would spread rapidly from this limited initial placement area and be distributed along the shoreline from DNR Monument R-121 to R-124. Nearshore hardbottom resources between DNR Monuments R-116 and R-121 would be directly impacted and buried by the initial fill placement for all fill volumes. In addition, nearshore hardbottom resources between DNR Monuments R-121 to R-124 would also be impacted over time as the placed fill would migrate and spread to the south.

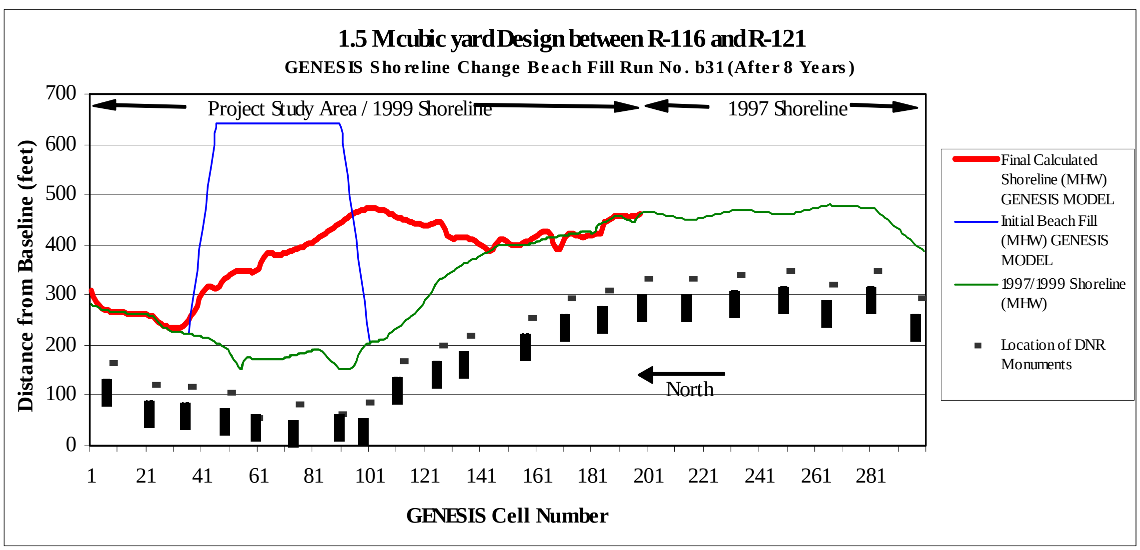
For the three potential fill volumes, the average placed sediment volume for the initial nourishment of Alternative 5 varies from 150 to 300 cy/ft over a total Project length of 5,000 feet. The mean dry beach width varies from approximately 200 to 430 feet following initial adjustment. Compared to the eight year renourishment interval for the Applicant's Preferred Alternative, the renourishment frequency for the Reduced Fill Area Alternatives is equal or greater (depending on the initial fill volume selected).

For the Applicant's Preferred Alternative, the MHWL is projected to be seaward of the initial shoreline between DNR Monuments R-118 and R-119 after 8 years. For a Reduced Fill Area Design using 750,000 cubic yards of sand, the GENESIS model results predict that, after 8 years, the shoreline would recede back to the initial pre-fill condition between DNR Monuments R-116 and R-119. Consequently, maintenance of the project would require renourishment of the beach

Figure 2.10 Reduced Fill Area Design Alternatives
GENSIS Modeling Results for Three Fill Volumes After 8 Years







between DNR Monuments R-118 and R-119 about every five to six years as opposed to every eight years for the Applicant's Preferred Alternative. Increasing the placement volume to 1.13 million cubic yards and 1.5 million cubic yards would extend the life of the Reduced Fill Area Alternative. As would be expected, the GENESIS model predicts that for these higher volumes, the MHWL would be more seaward than that of the Applicant's Preferred Alternative after eight years, at least in the vicinity of DNR Monuments R-117 and R-118. However, there would be no reduction in hardbottom impacts as the sand volume adjusts and spreads along the shoreline.

The Reduced Fill Area Design Alternative fails to significantly reduce the impact to hardbottom resources and, at volumes less than the Applicant's Preferred Alternative, would result in additional environmental impacts associated with more frequent renourishment intervals. In addition, reducing the placement area would limit the recreational beach available to the public and nesting marine turtles, and reduce the storm damage protection benefits of the project. Because this alternative only partially meets the Project Purposes and fails to reduce impacts to nearshore hardbottom, it was not beneficial and not evaluated in more detail.

2.3.3 Alternative 6 - Revetment

Revetments have been placed on beaches in the past to protect critically damaged or eroding areas, including in the area immediately north of the Project Area. These measures typically prevent erosion landward of the revetment but usually result in a steepening of the beach profile as sediment is carried off the beach. A revetment typically transfers erosion to beaches downdrift. The revetment north of Sloan's Curve has affected the Project Area in this manner. Construction of a revetment would not serve the Project purpose and need with respect to maintenance of a recreational beach or restoration of sea turtle nesting habitat. Consequently, this alternative was eliminated from detailed evaluation.

2.3.4 Alternative 7 - Seawalls

The construction of additional seawalls, or improvements to and maintenance of the existing bulkheads/seawall, would provide a significant degree of upland storm protection; however, this would be accomplished at the expense of maintaining a recreational beach, resulting in substantial economic loss to the area. Reflecting wave energy off the existing seawalls and bulkheads has resulted in a steepening of the offshore profiles with resulting hazardous bathing conditions due to increased undertow and runouts. A seawall would not serve the Project purpose and need and was therefore eliminated from detailed evaluation.

2.3.5 Alternative 8 - Nearshore Berm

In some areas, construction of a nearshore berm can help restore an eroding beach and provide a measure of storm protection to upland property. This alternative entails placing material offshore of the beach to create and mimic natural sandbar features under certain conditions. Material is typically dredged from an adjacent inlet or offshore borrow area. Recent improvements in dredging technology allow construction of nearshore berms in water depths of ≤15 feet. This alternative was eliminated from detailed evaluation because it fails to satisfy the Project purpose and need, provides minimal storm protection for upland properties, and does not restore the recreational beach or create sea turtle nesting habitat.

The nearshore berm alternative was extensively evaluated in the 1996 COFS. In the Phipps Project Area, the USACE determined that a nearshore berm placement was not appropriate and this alternative was eliminated from detailed consideration. The Applicant concurs with the USACE's determination on this matter in 1996, and also in the 1987 Palm Beach Island GDM/EIS. Specifically, construction of a nearshore berm would entail placement of fill seaward of the ephemeral nearshore hardbottom and would impact more sensitive hardbottom resources offshore. Overtime, sand migration from the nearshore berm to the beach would also impact ephemeral nearshore hardbottom resources. Overall, the nearshore berm alternative fails to meet the Applicant's specific project purposes and is unlikely to reduce impacts to nearshore hardbottom. No additional data or information has been brought forward that would call into question the previous determinations on this matter.

2.3.6 Alternative 9 - PEP Reef

In the last ten years, several offshore breakwater projects, called PEP reefs, were installed in an effort to reduce beach erosion in Florida, including Palm Beach County. In May 1988, approximately 552 feet of PEP reef was installed between DNR Monuments R-114 and R-116, at the DuPont Property north of the proposed Project Area in the Town of Palm Beach. These structures have proven ineffective in reducing shoreline erosion and, based on more than two years of monitoring data, the State ordered the PEP reef removed. In December 1991, the Town of Palm Beach was authorized to construct an additional 4,000 feet of experimental PEP reef in the Mid-Town Beach area. In August 1992, 57 structural units some 684 feet in length were installed along the approximate 9-ft depth contour. The remainder of the reef was installed by August 1993. Based on three-year monitoring data, the submerged breakwater was found to exacerbate erosion. The Town of Palm Beach elected to voluntarily remove the PEP reef and use the materials for groin construction. Because the experimental PEP reefs previously installed in the vicinity of the Project Area failed to prevent shoreline erosion or restore the recreational beach and sea turtle nesting habitat, this alternative was eliminated from detailed evaluation.

2.3.7 Alternative 10 - Groin Field without Beach Nourishment

Under some conditions, groins and other sand trapping structures installed in the absence of beach nourishment can trap longshore sediment transport resulting in the restoration of a beach. These structures have the added advantage of creating or mimicking the biological productivity of nearshore hardbottom resources. Typically, installation of a multiple-groin system (a groin field) provides a more favorable shoreline response than a single-groin alternative, since the shoreline exhibits a more uniform response, and the design dimensions are maintained over a greater length of the project. As described in Section 3.2, an annual sediment deficit exists in the

Project Area in excess of 100,000 cy/yr. Under these conditions, installation of a groin field without beach nourishment would not be expected to result in restoration of the recreational beach or creation of sea turtle nesting habitat. In addition, the Applicant's Preferred Alternative is more likely to maintain the design cross-section over the entire Project length during the eight-year renourishment interval. Therefore, the installation of groins in the absence of beach fill was eliminated from detailed evaluation.

2.3.8 Alternative 11 - Modification of the Lake Worth Inlet Sand Transfer Plant

Lake Worth Inlet, located approximately 8.5 miles north of the Project Area, completely interrupts longshore sediment transport from north to south, starving downdrift beaches of sand and causing shoreline erosion. To mitigate the downdrift impacts of the Inlet, Palm Beach County and the Town of Palm Beach in 1996 completed repairs to the Sand Transfer Plant (STP) located adjacent to the north jetty at the extreme south end of Singer Island. The sand transfer plant did not operate from May 1990 to May 1996. After May 1990, sand built up on the updrift beach and was subsequently removed by the sand transfer plant when sand pumping operations resumed in May 1996. As a result, the Reach 1 (from Lake Worth Inlet South Jetty to Onondaga Avenue) shoreline experienced a build up of sand for the period of September/October 1990 to April/May 1997. With the continued STP discharging of sand onto the north end of Palm Beach Island and placement of beach-quality sand in the disposal area by the USACE, two principal objectives of sand bypassing across the Inlet and maintenance of the navigation channel are at least partially satisfied. However, additional actions are necessary to appropriately manage Lake Worth Inlet and its adverse impacts to the Palm Beach Island shoreline. Recommended actions include:

- Extension and modifications to current USACE dredge spoil disposal practices.
- Place future maintenance dredged sand further downdrift (south) of the Inlet by extending the STP pipeline discharge point.
- Monitor the Inlet littoral processes, STP operations, and validate the Lake Worth Inlet sediment budget.
- Complete improvements to the STP capacity to enable it to achieve annual bypassing goals.

If these actions were implemented, one of the specific purposes of the proposed Project (correction of the ongoing sediment transport deficit created by the Inlet) would be achieved. However, this alternative does not address historical Inlet impacts and does not achieve the other Project purposes because several additional barriers to longshore sediment transport into the Project Area exist over the 8.5 miles from Lake Worth Inlet to the north boundary of the proposed Project. No reasonable expectation exists that further modification of the Lake Worth Inlet STP would restore the recreational beach at Phipps Ocean Park, create sea turtle nesting habitat in the Project Area, or reduce the potential storm damage in the area. This alternative was therefore eliminated from further detailed evaluation.

2.3.9 Alternative 12 - Dune Restoration

Under certain conditions, dune restoration can over time serve as an essential component for shoreline stabilization and restoration efforts. Typically, this alternative would include reconstruction of a sand dune or berm along the proposed Project length, installation of sand fences, and revegetation of the dune or berm with native plant species. The sand fences and vegetation serve to stabilize and maintain the dune. A dune restoration project would provide some storm protection, but would not in itself restore the recreational beach or create sea turtle nesting habitat. In addition, the vegetated dune and sand fences would reduce the dry beach area available for recreational use. For the Phipps Project Area, this alternative was appropriately eliminated in the USACE's 1996 COFS because dune restoration alone does not address the purpose of the project. The Phipps Project Area currently includes dune formations that would be quite adequate if fronted by a restored beach. Construction of a dune restoration project alone, without beach nourishment, would result in the continued loss of recreational beach area and potential turtle nesting habitat. However, a healthy dune system in the Project Area is beneficial and the Applicant will monitor the condition of the dunes and dune vegetation following construction of the Applicant's Preferred Alternative. If warranted by changed conditions, restoration of dunes and dune vegetation may be undertaken in the Project Area, as a supplement to the preferred design. Since this alternative fails to meet any of the Project purposes, detailed evaluation of this alternative is not warranted.

2.3.10 Alternative 13 - Navigation Project Modification or Abandonment

To correct the longshore sediment transport deficit in the Project Area, all inlets could be modified or abandoned. Removal or modification of jetties, sand transfer facilities, and channel alignments are under consideration through the State of Florida Erosion Control Program. However, substantial modifications or abandonment of inlets is unlikely in the short-term and the potential benefits of such actions in the Project Area are speculative at best. Since this alternative fails to meet all Project purposes, detailed evaluation of this alternative is not warranted.

2.3.11 Alternative 14 - Beach Fill with Periodic Nourishment Stabilized by an Offshore Breakwater

The construction of breakwaters or reefs offshore in the Project Area in association with beach nourishment could potentially reduce periodic renourishment quantities needed to maintain a protective and recreational beach fill. In some conditions, such structures can reduce the amount of wave energy reaching the shoreline in their lee. Typically, sand can be expected to collect behind the breakwater in a formation called a "partial tombolo" if the breakwaters are of sufficient size and are effective in decreasing wave energy and the rate of annual erosion. In some cases, these structures can thereby decrease the annual renourishment requirements. This alternative does not warrant detailed evaluation because of the additional cost of the breakwaters. In addition, adverse environmental impacts to turtle nesting could occur.

2.3.12 Alternative 15 - Beach Fill with Periodic Nourishment and Hurricane Surge Protection Berm

This alternative would help protect the shoreline from storm damages by reducing high hazard coastal flooding areas to general still water flooding areas. It is technically possible to construct a hurricane surge protection berm designed to prevent damages from hurricane-induced surges and wave runup and provide a relatively high degree of protection for the oceanfront structures. Design of an effective berm would require modification of the project design criteria and a detailed analysis of hurricane surge levels expected in the Project Area. The Applicant's Preferred Alternative is designed to provide protection to upland structures under a 15-year storm condition but would also achieve substantial reduction in structure damage in a 50- and 100-year storm event, without the necessity for a berm (see Section 2.1.3). Consequently, the addition of a berm is not economically justifiable in light of the project purpose. In addition, such a berm would not be aesthetically pleasing and could potentially interfere with marine turtle nesting and public use of the beach. This alternative does not warrant detailed evaluation.

2.3.13 Alternative 16 - Feeder Beach

This concept entails utilizing fill from offshore borrow areas, sand transfer plants, and truck hauls to provide for economical placement of material where it will nourish downdrift shores due to the predominate direction of littoral drift. This alternative can directly place sand into the littoral system but does not provide adequate beach for recreation and storm protection and does not fulfill the Project purpose and need. Appropriately, this alternative was not identified in the SEIS scoping process for detailed consideration in the FSEIS and no previous USACE shoreline assessments of the Project Area have proposed a feeder beach. If substantial sand were placed in the nearshore waters, a regional feeder beach would significantly increase the impact to the nearshore hardbottom resources. Detailed evaluation of this alternative is not warranted at this time.

2.3.14 Alternative 17 - Removal of Groins

Removal of the groins north of Phipps Ocean Park would eliminate some of the impediments to southerly longshore transport to the Project Area. Groins updrift of the Project Area are generally described by shoreline reach in Section 3.2.3. The existing groins north of Phipps Park deter southerly longshore transport to Phipps Ocean Park and the Project Area. In spite of beach nourishment at Mid-Town, southerly transport of this sand must fill the “monster” groin at Widener's Curve and others before the Project Area begins to receive sand transported downdrift from the Mid-Town beach nourishment. Periodic nourishment at Mid-Town over a matter of decades may fully impounded the groins north of Reach 7 and allow longshore sediment transport to enter the Project Area uninterrupted, and removal of some groins could accelerate this outcome.

For the foreseeable future, groin removal would have a positive but largely inconsequential benefit to the Project Area by allowing somewhat less hindered longshore sediment transport into the Project Area. However, these groins are privately owned and beyond control of the Town and the USACE. Prior to initiating a program to force removal of private groins and similar structures, the legal ramifications and potential liabilities to the USACE and Applicant would need to be fully explored. Such an analysis has not been undertaken and is not warranted at this time. Finally, even if the groins were removed, existing seawalls and revetments can also function as headland features that deter longshore transport to the Park. In light of the above, removal of groins is not a feasible alternative at this time.

2.4 Alternatives Not Within Jurisdiction of the Lead Agency

This section describes alternatives that may to some extent fulfill the Project purpose and need but which are beyond the jurisdiction of the lead agency to permit or authorize. These "extra-jurisdictional" alternatives are generally within the authority of a local government to implement and include such measures as land use controls or limitations and restrictions on construction.

2.4.1 Rezoning of Beach Area

Rezoning of the beach area to restrict or limit future upland construction could in some areas effectively reduce the risk of storm damage to upland structures associated with shoreline retreat. In the Project Area, upland development has already occurred and rezoning the area would not result in any substantial reduction in potential risks to upland property. This alternative fails to achieve the Project purpose and need.

2.4.2 Modification of Building Codes

Existing Florida building codes include structural requirements intended to minimize potential impacts to the beach-dune system and reduce building damage in severe storm events. The Project Area is extensively developed and while many of the structures do not conform to current building standards, these buildings are generally exempt from existing codes unless they are substantially modified. Modification of the building codes could reduce storm risks associated with the current condition of the shoreline; however, it fails to address the principle Project purposes to restore the recreational beach, create sea turtle nesting habitat, and mitigate for the disruption of longshore sediment transport by updrift structures.

2.4.3 Construction Setback Line

A construction setback line would not affect existing development and could only be effective in the unforeseeable future as buildings are razed and destroyed by storms and replaced, and as buildings are constructed on the remaining undeveloped land. The State of Florida has established construction control lines along the shores of coastal counties and through a construction permit program; these lines are controlling development along Florida's coastline. Like the modification of building codes, this alternative is insufficient to achieve the Project purpose and need.

2.4.4 Construction Moratorium or No Growth Program

Assuming local interests would accept a moratorium on future construction, implementation of such a policy would have little impact on the level of storm risk associated with the current erosion affecting the Project Area and would not achieve the Project purpose or need relative to the recreational beach or sea turtle nesting habitat. More importantly, a no-growth program would be ineffective in this area since the majority of the area has already been developed. This alternative is currently insufficient to fulfill the Project purpose and need.

2.4.5 Evacuation Planning

Similar to other extra-jurisdictional alternatives, improved evacuation can potentially reduce the loss of life during severe storm events and should be pursued by appropriate State and local emergency management officials. However, this alternative does not address the Project purpose or need.

2.4.6 Condemnation of Land and Structures

Local governments have the power, under certain prescribed conditions, to condemn land or structures as may be determined to be in the public interest. Removal of condemned structures can also be justified and legally undertaken under limited conditions. Assuming such a policy could be implemented in the upland areas adjacent to the Project Area, and all structures could be removed, this alternative would allow the shoreline to erode until equilibrium is established. This alternative is typically considered along undeveloped shorelines, but is inappropriate in this case because of the extensive development of the upland Project Area.

2.4.7 Relocation or Retrofit of Structures

The relocation of the structures would allow the area to continue to erode and the land in this area would be lost until an equilibrium shoreline is reached. However, most structures within the area cannot be economically moved from the area that would be lost. In addition, implementation of this alternative would result in the loss of valuable recreational beach and would necessitate the condemnation of the land and structures in highly developed areas. This alternative is not viable. Flood proofing of existing structures and regulation of flood plain and shorefront development are appropriate, but would not fulfill the Project purpose and need.

2.5 Comparison of Alternatives

Table 2.4 lists alternatives considered and summarizes the major features and consequences of the Applicant's Preferred Alternative and other alternatives considered in detail. See Section 4.0, Environmental Consequences, for a more detailed discussion of impacts of alternatives.

2.6 Mitigation

The Applicant's Preferred Alternative will result in direct burial of a total of 3.1 acres of nearshore hardbottom. The persistent nature of these exposed rock features is an indicator of the severity of the erosion in the Project Area. As the shoreline has continued to erode, nearshore rock outcrops generally become more exposed. There is also significant movement of sand throughout the nearshore area and variability in the specific configuration of exposed rock areas. As a result, the ephemeral rock configurations are characterized primarily by opportunistic fouling communities. The Applicant proposes to construct a 3.1 acre mitigation reef constructed of limestone boulders to compensate for burial of nearshore hardbottom in the Project Area. Appendix E, Mitigation Reef Plan and Monitoring Program, outlines the proposed mitigation method, technique, and area based on the Project permit issued by FDEP. The final mitigation plan would be developed in coordination with the FDEP, federal resource agencies, Palm Beach County DERM, and the USACE.

The borrow areas are designed to provide a sufficient buffer (presently planned at 400 feet to 524 feet of offshore hardbottom) to avoid impacts to offshore hardbottom communities from turbidity, sedimentation and mechanical damage. Precision positioning of equipment, with a Geographic Positioning System (GPS), will aid in avoiding sensitive areas. Section 4.27 Environmental Commitments (Mitigation), discusses other procedures that will be implemented to avoid or minimize potentially adverse environmental impacts.

Table 2.4 Comparison of Direct and Indirect Impacts for Alternatives Evaluated in Detail

Resource	Alternative 1– No Action	Alternative 2- Beach Fill with Groins	Alternative 3 - Applicant's Preferred Alternative
TOTAL COST	Construction - 0 - Net land losses - $18 mil* Armoring costs - $2.3 mil*	Initial fill - $8.55 mil Groins - $1.64 mil Mitigation - $750,000 Renourishment - $5.1 mil	Initial Fill - $8.55 mil Mitigation - $750,000 Renourishment - $5.1 mil
TIDES, WAVES, CURRENTS & STORM EVENTS	No impact	Insignificant	Insignificant
SEDIMENT QUALITY	No impact	Insignificant Native beach sediment characteristics maintained.	Insignificant Native beach sediment characteristics maintained
VEGETATION	No impact	Increased storm protection to dune and beach vegetation. Seagrass beds absent.	Increased storm protection to dune and beach vegetation. Seagrass beds absent.
THREATENED & ENDANGERED SPECIES	This critically eroded area will continue to erode over the next 30 years. Sea turtle nesting areas would continue to decrease in area as beaches erode. Continual erosion into the dune areas during storm events may threaten endangered dune species.	No impact to manatees or whales expected. Beach fill activities could impact sea turtle nesting or hatchling success.	No impact to manatees or whales expected. Beach fill activities could impact sea turtle nesting or hatchling success.
HARDBOTTOM AND REEFS	Additional nearshore hardbottom could become exposed.	Burial of some nearshore hardbottom. Temporary increase in turbidity and sedimentation rates over nearshore hardbottom communities. A 400-ft buffer zone in which dredging is prohibited will be maintained to avoid impacts to offshore reef areas. Groins will provide additional habitat for displaced communities.	Burial of 3.1-acres of nearshore hardbottom. Temporary increase in turbidity and sedimentation rates over nearshore hardbottom communities. A 400-ft buffer zone in which dredging is prohibited will be maintained to avoid impacts to offshore reef areas. No net adverse or significant impact on hardbottom communities.

Table 2.4 Comparison of Direct and Indirect Impacts for Alternatives Evaluated in Detail

Resource	Alternative 1– No Action	Alternative 2- Beach Fill with Groins	Alternative 3 - Applicant's Preferred Alternative
FISH AND WILDLIFE RESOURCES	No impact	Temporary impact on benthic organisms at beach fill construction site. Habitat improved with construction of groin and mitigation reef.	Temporary affect on benthic organisms at beach fill site. Habitat improved with construction of mitigation reef.
ESSENTIAL FISH HABITAT	No impact	Direct impact to hardbottom habitat. Minimal indirect impact. Burial of 3.1 acres of ephemeral hardbottom. Temporary displacement of fishes from nearshore areas during dredging and fill placement, temporary reduction of water quality due to turbidity during dredging operations and temporary decrease in primary productivity until completion of nourishment. Construction of the mitigation reef prior to nourishment will offset impacts and create habitat more productive than the nearshore ephemeral habitat impacted by the Project.	Direct impact to hardbottom habitat. Minimal indirect impact. Burial of 3.1 acres of ephemeral hardbottom. Temporary displacement of fishes from nearshore areas during dredging and fill placement, temporary reduction of water quality due to turbidity during dredging operations and temporary decrease in primary productivity until the completion of nourishment. Construction of the mitigation reef prior to nourishment will offset impacts and create habitat more productive than the nearshore ephemeral habitat impacted by the Project.
COASTAL BARRIER RESOURCE AREAS	There are no designated Coastal Barrier Resource Act units located within or adjacent to the Project Area.	There are no designated Coastal Barrier Resource Act units located within or adjacent to the Project Area.	There are no designated Coastal Barrier Resource Act units located within or adjacent to the Project Area.
WATER QUALITY	No impact	Minimal and temporary impacts to water quality due to increase in turbidity and suspended sediments near the borrow and beach fill areas.	Minimal and temporary impacts to water quality due to increase in turbidity and suspended sediments near the borrow and beach fill areas.

Table 2.4 Comparison of Direct and Indirect Impacts for Alternatives Evaluated in Detail

Resource	Alternative 1– No Action	Alternative 2- Beach Fill with Groins	Alternative 3 - Applicant's Preferred Alternative
HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE	No impact	No impact	No impact
AIR QUALITY	No impact	Construction equipment exhaust emissions add temporary and insignificant levels of pollutants.	Construction equipment exhaust emissions add temporary and insignificant levels of pollutants.
NOISE	No impact	Temporary increase in noise during construction from onshore bulldozers and booster pumps, offshore dredge, and clam bucket on dredge during stone placement.	Temporary increase in noise during construction from discharge pipe and booster pumps, onshore bulldozers, and offshore dredge.
AESTHETIC RESOURCES	Negative impact. Continued erosion will diminish the recreational beach and natural vegetation and habitat found on the beach.	Provides for an extended beach width for public recreation and upland vegetation.	Provides for an extended beach width suitable for public recreation and upland vegetation.
RECREATIONAL RESOURCES	Negative impact. Continued erosion will likely expose additional nearshore hardbottom making beach unsuitable and unsafe for public use.	Beach use will be temporarily impacted during construction. Temporary turbidity may degrade diving and snorkeling around borrow and nourishment areas. Groin boulders will provide additional snorkeling opportunities in the future.	Beach use will be temporarily impacted during construction. Temporary turbidity may degrade diving and snorkeling around borrow and nourishment areas. Mitigation reef will provide additional diving and snorkeling opportunities in the future.
HISTORIC PROPERTIES	No impact.	No impact. Buffers have been established to avoid impacts to detected magnetic anomalies in borrow areas III and IV in coordination with SHPO (see section 4.6).	No impact. Buffers have been established to avoid impacts to detected magnetic anomalies in borrow areas III and IV in coordination with SHPO (see section 4.6).

* Based on 15-year project.